

STUDIES IN THE BORAGINACEAE, XXIX.
ECHIOCHILON AND RELATED GENERA

IVAN M. JOHNSTON

THE THREE GENERA here discussed, *Megastoma*, *Sericostoma* and *Echiochilon*, include a total of nineteen species endemic in the deserts of northern Africa (Senegal to Somaliland), Arabia, Iran, and Pakistan. Most of these species are rare or very local and subsequent to their original description have been mentioned only briefly and rarely, if at all, in the literature. The many unique or very uncommon features to be observed in the floral structure of these plants have been overlooked or unappreciated.

The relationship of the three genera to the other members of the Boraginoideae is not clear. Although they have features prevailingly suggestive of a relationship among the Lithospermeae, in fruiting structures they are most like the Eritrichieae. Our genera seem to have no obvious direct relations with any of the Old World Boraginoideae. Surprisingly, they seem to be in greatest agreement with *Amblynotopsis* of Mexico and *Antiphytum* of southern Brazil and Uruguay.

Preliminary work on the present report was carried on at the British Museum of Natural History, in the Herbarium at Kew, and in the Herbarium of the Natural History Museum in Paris during a visit to Europe in 1952. Through the kindness of those in charge, I was able to borrow selected specimens from these herbaria for detailed study at the Arnold Arboretum. Subsequently, recently accessioned new collections of *Echiochilon* at Kew and the British Museum have been sent me on loan for identification by Mr. E. Milne-Redhead and Miss Hillcoat. Also of great interest and usefulness has been the loan of the Somali *Echiochilon* from the Botanical Institute, Florence, loaned me by Professor R. E. G. Pichi-Sermolli.

KEY TO THE GENERA

- Corolla glabrous inside, minute, shorter than the calyx, throat bearing five obscure weak circular convex invaginations; anthers affixed at or below the middle, becoming dorsiventrally compressed; pollen 3-porate; small annual herbs ranging from the Canary Islands, across North Africa to eastern Arabia. I. *Megastoma*.
- Corolla abundantly and conspicuously villose in the throat, throat not at all invaginate; anthers affixed above the middle, becoming strongly compressed laterally; pollen usually 2-colpate but in a few species sometimes also 3-colpate; plants usually fruticose and perennial, only one species annual.
- Gynobase plane or even depressed at the center; nutlets with a stout downward directed stipe bearing the attachment at its lower end; stigmas terminal, projecting above the sterile tip of the style; filaments affixed at the summit of the corolla-throat directly beneath the base of the corolla-sinus;

corolla-lobes equalling or even longer than the tubular portion (i.e., tube + throat) of the corolla; calyx deciduous at maturity, the lobes strongly imbricate; cymes usually glomerate, few-flowered; plant of Pakistan and adjacent India. II. *Sericostoma*.

Gynobase elevated, attenuate, usually narrowly pyramidal and more than half the height of the nutlets; stigmas subterminal, always surpassed by the protracted sterile tip of the style; nutlets with a prolonged sessile lateral attachment; filaments affixed deep in the corolla-throat; corolla-lobes shorter than the tubular portion of the corolla; calyx persistent, the lobes valvate or at least not evidently imbricate; corolla small to large, radially symmetric to strongly zygomorphic; inflorescence usually with numerous flowers, usually elongating and becoming unilaterally racemose.

. III. *Echiochilon*.

- I. **Megastoma** Coss. & Dur. ex Benth. & Hook. Gen. Pl. 2: 851 (1876), in synonymy; Bonnet & Barratte, Ill. Phan. Tunis. t. 11, f. 4-11 (1895), illustration with analysis; Bonnet & Barratte, Cat. Pl. Vasc. Tunis 301 (1896), description; Johnston, Contr. Gray Herb. 73: 64 (1924) and 74: 19 (1925); Brand, Pflanzenr. Heft 97: 77, f. 6 (1931). — Type species: *M. pusillum* Coss. & Dur.

Small annual herb, much branched, erect or becoming decumbent, cinereous with abundant appressed hairs, lowest leaves and branches opposite; leaves all cauline, narrow, abundant; plant fertile nearly throughout and hence developing no sharply delimited inflorescences; flowers produced abundantly along nearly all the leafy stems and branches to form very numerous ill-defined unilateral racemose clusters, the inflorescence never scorpioid; calyx 5-parted, accrescent, base rounded and usually developing a stout pedicel, lobes linear, decidedly unequal (especially in age), connivent in fruit, smallest lobe adaxial, largest lobe one of the two abaxial lobes; corolla white or slightly yellowish or pinkish, minute, shorter than the calyx-lobes, regular, subtubular, completely glabrous or with only a few minute hairs on the outer surface of some corolla-lobes; lobes small, ovate, erect or ascending, rounded at summit; tube (including the throat) cylindrical, 3-4 times as long as the lobes; throat not differentiated as to form, inside bearing an ill-defined, circular, low-convex, weak invagination a short distance below each corolla-lobe; annulus not developed; stamens 5, equal, included in the lower half of the corolla-tube; filaments about as long as the anther, arising all at the same elevation very low in the corolla-tube; anther ovate or somewhat cordate, attached at or slightly below the middle, dorsiventrally compressed even after dehiscence, broader than thick and broadest above the base, apex obtuse and sometimes more or less apiculate, base broad and somewhat cordate; thecae distinct but remaining closely juxtaposed below the middle of the anther, their bases rounded or sometimes somewhat apiculate; connective linear, inconspicuous; pollen with 3 coarse circular pores, in polar profile three-sided with the pores forming the truncate corners, ca. 20 μ broad, in lateral profile elliptic ca. 14 μ high and 20 μ broad, the pores equatorial; gynobase elongate, erect,

narrowly pyramidal, 4-angled, from just above the broadened base gradually narrowed to the pointed apex which bears the short style, after the fall of the nutlet the concave sides of the gynobase above the middle commonly bearing a short bristle-like section of the funicle projecting vertically from the broken end of the funicular canal; stigmas terminal, deeply bilobed, lobes subglobose, usually barely surpassing the tips of the nutlets in height; nutlets lance-ovate, usually all four maturing, back convex, base rounded, apex acute, venter with the suture open to form a conspicuous, elongate, narrowly triangular attachment-scar; attachment-scar distinctly lateral, extending from just above the nutlet-base upward almost to the nutlet-apex, $2-2\frac{1}{2}$ times as long as broad, all in a single nearly vertical plane except the broadened lower end which may be slightly oblique and slope somewhat towards the nutlet-base.

Megastoma pusillum Coss. & Dur. in Bonnet & Barratte, Ill. Phan. Tunis. *t.* 11, *f.* 4-11 (1895) — Type from "Tunisie méridionale: alluvions de l'*Qued Zitoun* (Letourn.)."

Small herb, 2-15 cm. tall, usually repeatedly branched, clothed with closely to loosely appressed stiffish straight pale hairs 0.5-1 mm. long; cotyledons frequently persisting even on fruiting plants, blades orbicular, ca. 2 mm. diameter, supported on a very broad short petiolar base which is connate and sheathing below the middle, lower surface of cotyledon glabrous, upper surface hispidulous, the hairs pale and bulbous at the base; leaves numerous, linear or oblanceolate-linear, 5-25 mm. long, 1-2.5 mm. broad, largest ones towards the base of the plant, flat or more or less conduplicate, thickish, veinless, midrib prominent if at all only on the lower surface, both leaf-surfaces bearing appressed stiff hairs arising from thickened bases, apex of blade obtusish or sometimes acute; flowers abundant, borne along most of the leafy stems and forking branches and, in the fruiting state, forming many leafy-bracted unilateral racemes 2-6 cm. long; calyx at anthesis 2-3 mm. long, becoming 4-7(-10) mm. long in fruit, frequently with a pedicel 0.5-1 mm. long; corolla 2-2.5 mm. long, lobes 0.6-0.7 mm. long and nearly as wide, tube about 1 mm. thick, faucal invaginations weak and obscure, 0.2-0.3 mm. diameter, borne about 0.2 mm. below the base of the corolla-lobes; filaments 0.2-0.3 mm. long, arising 0.5-0.7 mm. above the base of the corolla-tube; anthers 0.25-0.3 mm. long, 0.2 mm. broad; gynobase narrow, elongate, 0.1-1.4 mm. tall, ca. 0.5-0.8 mm. broad at the very base; style 0.2-0.3 mm. long; nutlets 1.3-1.8 mm. long, ca. 1 mm. broad above the base, usually sparsely verrucose, with a narrowly triangular lateral scar almost as long as the nutlet-body.

Canary Islands, western Mauritania and southern Morocco eastward, in Algeria, Tunis, Egypt and eastern Arabia, usually in deserts and chiefly in sandy places.

CANARY ISLANDS: Fuerteventura near port of Tarajalejo, sand, April 1912, *O. Burchard* 335 (K). MAURITANIA: Tasiast, Oued Tenebrouret, ca. lat. 21°, long. 15-16°, abundant, Feb. 2, 1937, *Murat* 1946 (G). ALGERIA: El Golia, in

petrosis aridissimis, March 29, 1904, *L. Chevallier* (K); Ghardaia, in aridis glareosis, Feb. 1902, *L. Chevallier* 455 (G); Biskra, sur les collines incultes, May 10, 1853, *B. Balansa* (G). EGYPT: Arabian Desert near Ain Shams to the north of Heliopolis, May 8, 1908, *Emile Burdet* 341 (G); in deserto Belbeys, *Schubert* (K). ARABIA: Kuwait, Airdrome, sandy soil, corolla minute white or pinkish, May and June, 1935, *Dickson* 209 and 253 (K); Bahrain Island, desert at pipeline, Awali wadi, March 13, 1950, *R. Good* 215 (K); Bahrain Island, Jebel Dukhan, March 16, 1950, *R. Good* 216 (K, BM); Jabal Hafit, Oman, April 25, 1948, *W. Thesiger* (BM).

The genus *Megastoma* is notable for its very small subtubular corollas which are shorter than the very unequally lobed calyx. The corolla has very obscure faucal swellings but no differentiated annulus, and is completely glabrous except for a few minute hairs on the outer surface of some of the corolla-lobes. The anthers are short and broad and cordate at the base. The thecae are distinct from the base upward nearly to their middle and almost to the attachment of the anther.

The nutlets and gynobase are beautifully illustrated by Bonnet & Baratte, the swellings in the corolla-throat, which they failed to notice, are shown somewhat diagrammatically in the figure given by Brand. Both Bonnet & Baratte and Brand incorrectly illustrated and described the stigmas of *Megastoma* as simple and capitate. Actually the stigma is bilobed and frequently almost completely divided. Under high magnification it usually appears to consist of two closely juxtaposed subglobose stigmas terminal on the style.

II. *Sericostoma* Stocks ex Wight, *Icones Pl. Ind. Orient.* 4²: 15, *t.* 1377 (1848). — Type species: *S. pauciflorum* Stocks ex Wight.

A low spreading shrub with numerous slender much-branched stems, strigose, cinereous; leaves oblanceolate, oblong, or lanceolate, usually acute, thickish, loosely conduplicate, veinless, midrib evident if at all only on lower surface, lowest leaves on the shoot opposite; inflorescence terminal on the branches and branchlets, 3–6-flowered, at first glomerate but eventually short-racemose, bracts 1–2; calyx 5-fid, base thickened and elongate in age and eventually disarticulating; lobes imbricate, lanceolate, acute, subequal; corolla radially symmetric, white, minutely villulose on the surface of some of the corolla-lobes but otherwise glabrous outside, inside abundantly white villose in the throat; lobes as long as the corolla-tube or slightly longer, oblong, minutely lacerate near apex, spreading or recurving; tube (including the undifferentiated throat) stout, weakly ampliate; stamens almost completely exerted; filaments subulate, equal, about as long as the anther, affixed at the top of the throat directly beneath the sinus, anther narrowly oblong, erect, affixed above the middle, with rounded ends, in age with thecae explanate and back to back with the pallid inner surfaces parallel and facing laterally in opposite directions, the dehisced anthers accordingly appearing to be very strongly compressed laterally; connective very narrow and inconspicuous; pollen bicolpate,

usually more or less bilaterally symmetric, 19–23 μ high, 21–24 μ broad, polar profile elliptic, lateral profile quadrate to transversely rectangular; gynobase not elevated, a cartilaginous disk, plane or somewhat depressed at the center, scarred by large circular excavations after the fall of the nutlets; style arising directly from the center of the discoid gynobase, shorter than the nutlets; stigmas 2, as long or longer than broad, vesicular, pallid, swollen, terminal, separated across the apex of the style by a narrow band of sterile styler tissue but the two stigmas always evidently projecting above it; nutlets 1–4, usually only one maturing, ovoid, abundantly verrucose and tumulose, gray, reddish or brownish, ascending, supported on a short stout vertical laterally affixed stipe; axial edge of nutlet obtusely angulate, straight and vertical or nearly so, formed above the middle by the short low ventral keel on the nutlet-body and below the middle by the ventral side of the stipe, traversed from apex of nutlet to base of stipe by the closed and completely fused ventral suture; seminiferous body of the nutlet ovoid, inclined at an angle of about 60° , its pointed apex held high above nutlet-attachment and its rounded base held directly abaxial to the attachment; stipe stout, solid, smooth on sides, bearing the convex attachment-scar on its horizontal lower end, attached to the body of the nutlet on the sloping underside of the latter just below its middle; funicular canal ascending vertically inside the stipe and entering the seminiferous body of the nutlet just below the middle on the ventral side; seed compressed ovoid with a short radicle, the funicle attached half way up the ventral side of the seed.

A monotypic genus known from Pakistan and adjoining western India.

Sericostoma pauciflora Stocks ex Wight, *Icones Pl. Ind. Orient.* 4²: 15, *t.* 1377 (1848); Hooker, *Icones* 9: *t.* 804 (1852) — Type from Baikur near Deesa, Scinde, *Stocks*.

Sericostoma parviflorum Stocks ex Walp. *Annal.* 3: 135 (1852), lapsus calami.

Stems numerous, 1–5 dm. long; old stems woody, with rough dark bark, 1 cm. or more thick; leaf-bearing branches 1–2 dm. long, 1–2.5 mm. thick, bearing straight, closely appressed hairs 0.2–0.6 mm. long; leaves all cauline, numerous, 5–35 mm. long, 2–10 mm. broad, strigose on both surfaces (hairs closely appressed 0.2–0.6 mm. long, most of them arising from discoid, mineralized bases), lowest leaves on the shoot and branches always forming 1–2 opposite pairs; cymes not scorpioid, usually about 4-flowered, at first glomerate and ca. 5 mm. in diameter, in age more loosely flowered on an axis 5–12 mm. long; bracts 1–2, inconspicuous, 1–3 mm. long; calyx strigose outside, inner surface glabrous, at anthesis 2.5–3 mm. long, with a short broad base, subsessile, lobes 0.7–1.2 mm. long; calyx at maturity having weakly accrescent lobes but an enlarged base, tending to become nutant and at extreme maturity to disarticulate from the inflorescence and to fall away with the nutlet still embraced by the connivent lobes, calyx-base thickened, angulate, elongate and frequently more or less pedicellate; corolla rotate, usually about 5 mm. diameter; lobes 1.5–2 mm. long, 1–1.7

mm. broad, usually with conspicuous dichotomous veins; tube 1.2–1.8 mm. long, 0.8–1.2 mm. thick, gradually but weakly ampliate from the base upward, upper half of tube (i.e. the throat) densely and conspicuously white-villous inside, below the middle of the tube glabrous inside except for a narrow inconspicuous villulose band (marking the site of the undeveloped annulus) ca. 0.2 mm. above the corolla-base; filaments 0.8–1 mm. long; anthers 0.8–1 mm. long, erect; gynobase ca. 1 mm. broad at anthesis, becoming 1.5–2 mm. broad when maturing all four nutlets, scar left by the detached nutlet a shallow excavation ca. 0.5 mm. diameter; style 1–1.3 mm. long, sterile apex surpassed by at least one-fourth of the length of the stigmas; nutlets 2–2.4 mm. long, ca. 1.5 mm. broad, ovoid, usually somewhat lustrous, with a rounded base, a convex dorsum and a broadly acute apex, body of nutlet supported on the sloping ventral under side by a stout vertical stipe 0.5 mm. long and almost 0.5 mm. in diameter; attachment-scar of nutlet on the base of the stipe, rough, convex, situated in the same horizontal plane as the base of the nutlet-body and adjacent to the latter and adaxial to it.

Dunes and other sandy places, chiefly in desert areas and along the coast, in southern Pakistan and in adjacent westernmost India.

SPECIMENS STUDIED: Scinde, *Stocks in Hook. & Thomson, Herb. Ind. Orient.* (G); Southeast Punjab, 1886, *J. R. Drummond 25988* (K); Punjab, *J. R. Drummond 25987* (K); Baikur near Deesa, *J. E. Stocks 61* (K); coast of Kathiawar, plentiful low-spreading shrub, *Dalzell* (K); Nargol, open formations in sand along sea, Feb. 24, 1912, *H. M. Chibber* (K); without locality, *V. Jacquemont 59* (G).

As here redefined, *Sericostoma* is reduced to its original species from Pakistan. Plants of Persia, Arabia, and Somalia previously assigned to this genus are now referred to *Echiochilon*. The two genera, although separable by characters of fundamental importance, are close relations, sharing such distinctive features as bicolpate pollen, vesicular stigmatic tissue, villose corolla-throat, and opposite lowermost leaves. In both the anthers are supramediately affixed and have the inner surfaces of the theca pallid, sparsely and very minutely strigose and eventually explanate. Formerly only plants with excessively zygomorphic corollas were referred to *Echiochilon*. Plants with radially symmetric or with only obscurely zygomorphic corollas were referred to *Sericostoma*. The separation of the two genera on this basis, however, can be supported by no other character and is obviously artificial. As now circumscribed, the monotypic genus *Sericostoma* has numerous characters of fundamental importance. Its nutlets are stiped and are borne on a plane, discoid gynobase. The ventral suture on its nutlets is completely closed and the margins fused all the way from the apex of the nutlet-body down to the nutlet-attachment at the base of its stipe. The style arises directly from the center of the discoid gynobase. Its sterile apex is not prolonged upward above the apices of the stigmas. The stigmas are distinct and are as long or longer than broad. They are not laterally prolonged and together do not form a stigmatic band around the

style just beneath its sterile apex. The stamens are borne at the top of the throat directly beneath the base of the corolla-sinus and are almost completely exerted. The calyx has obviously imbricate lobes and eventually is deciduous while still embracing the mature fruit.

III. *Echiochilon* Desf. Fl. Atlant. 1: 166, t. 47 (1798). — Type species: *E. fruticosum* Desf.

Chilochium Raf. Ann. Gen. Sci. Phys. 8: 269 (1821). — A proposed substitute name for *Echiochilon* Desf. (1798).

Exioxylon Raf. Fl. Tellur. 4: 85 (1838). — Apparently based upon *Echiochilon* Desf. (1798).

Leurocline Moore, Jour. Bot. 39: 257, t. 424 (1901). — Type species: *L. lithospermoides* Moore.

Echiochilopsis Caballero, Trab. Mus. Nac. Cien. Nat. Madrid, Bot. 30: 10, t. 2 (1935). — Type species: *E. coerulea* Cab. (= *Echiochilon chazaliei* (Boiss.) Johnston).

Tetraedrocarpus O. Schwartz, Mitt. Inst. allgem. Bot. Hamburg 10: 212 (1939). — Type species: *T. arabicus* O. Schwartz.

Plant usually perennial, with widely spreading erectly or ascendingly branched frutescent old stems, herbaceous and annual in one species only, bearing sparse to abundant strongly to loosely appressed hairs on stems and leaves and usually a few spreading hairs on the leaf margins, the hairs on the leaves frequently arising from well developed mineralized discoid bases, surface of the herbage glaucescent in a few species and bearing abundant minute stiped glands in two others; leaves all cauline and prevailingly alternate, the lowest on the shoot smaller than those directly above and always opposite, leaves all opposite only in one species; leaves thickish, firm or somewhat succulent, narrow and elongate and usually without visible veins or midrib, tending to be loosely conduplicate or have the margins somewhat involute, inflorescence few- to many-flowered, bracteate throughout, consisting of flowers interspersed among the leaves along the outer half of the leafy shoot or of flowers aggregated into an erect, elongating, racemose cluster terminating the leafy stems and branches, never developing a distinctly scorpioid apex; calyx 5-fid, subsessile or with a short stout strict pedicel; lobes erect, usually elongate, oblong to lanceolate or oblanceolate, all similar or nearly so or in a few species very unequal, distinct or rarely united at the very base to form a very short tube, when unequal the smallest lobe always adaxial and the largest lobe always one of the abaxial pair; corolla white, lilac, blue or reddish purple, in some species light colored at anthesis and then changing to blue or purple in age, short to elongate, hypocrateriform, funnelform or funnelform-tubular, small to moderately large, radially symmetric to very strongly zygomorphic, outside commonly strigulose or villulose but sometimes glabrous or bearing only minute stipitate glands; corolla-limb horizontal (i.e., on all sides diverging at 90° from the long axis of the corolla) or weakly to extremely oblique (i.e., highest on the adaxial side and sloping downward, gently to very steeply, towards the low abaxial side), in zygomorphic corollas the 2-lobed adaxial

side always best developed and its lobes always erect, the forward lip in zygomorphic corollas usually spreading or loosely decurved and evidently 3-lobed but in one species reduced to a very narrow recurved unlobed rim; corolla lobes rounded, obovate to ovate or semicircular, all similar or differing more or less in size and shape, sometimes with conspicuous dichotomous veining or with crisped margins, in radially symmetric corollas the lobes all similar and equally spreading or sometimes the 2 adaxial lobes less widely spreading than the other three, in distinctly zygomorphic corollas the 2 erect adaxial lobes the largest, the medial abaxial lobe the smallest, and the 2 anterior laterals intermediate in size; corolla-throat densely villose inside with white or yellow hairs, bearing neither appendages nor glands, gradually expanding or campanulate, usually about as long as the tube, in zygomorphic corollas most prolonged on the adaxial side, most swollen on the abaxial side, and the upper margin evidently oblique; corolla tube without a well developed annulus, the latter absent or represented by an indistinct broad, very low-convex annular ridge which is either glabrous or inconspicuously villulose; stamens 5, arising from among the abundant hairs deep in the throat, all borne at the same distance above the corolla-base or with the adaxial stamen highest, the forward abaxial pair lowest, and the abaxial lateral pair at an intermediate level; filaments equal or unequal, from very short (merely unguiculate) to almost as long as the anther; anthers affixed above the middle, included or short-exserted, elongate, narrowly oblong with rounded summit, base rounded with short sinus, connective very narrow and inconspicuous; thecae becoming explanate and reflexed after dehiscence, the backs of the open thecae juxtaposed and the flattened pallid inner surfaces of the thecae parallel and facing in diametrically opposite directions, the empty anthers accordingly very pale, very strongly compressed laterally and bearing the filament-attachment in a deep cleft on the narrow dorsal side; pollen usually 2-colpate, and commonly more or less bilateral, 13–21 μ high and 15–24 μ broad, subcylindric and commonly broader than long, polar profile circular to elliptic or rhombic, lateral profile quadrate to transversely oblong; pollen rarely 3-colpate, 13–16 μ high, 15–23 μ broad, polar profile circular or 3-sided, lateral profile transversely ovate or elliptic; gynobase from a broad base medially and abruptly narrowed into a usually 4-sided slender attenuate upward prolongation (usually equalling the nutlet in height), the central upward prolongation commonly buttressed below the middle by 4 triangular wings, the nutlets usually attached in the (frequently excavated) angle between the wings of the gynobase and higher up along the usually sulcate side of the upward prolongation of the gynobase, in one species the nutlet not attached between the buttresses of the gynobase but only along the crest of the buttresses and, higher up, along the sides of the central upward prolongation; style short to moderately elongate, usually extending up only to the base of the corolla-throat, never exerted, terminating the central upward prolongation of the gynobase, slender, entire or, in one species, very shortly bilobed at the apex,

cylindric and equally thick throughout or sometimes slightly thickened just below the summit, bearing the stigmas always below the variously modified sterile summit; on simple styles which bear horizontal stigmas the sterile apex of the style low-convex to domed or short-cylindric, entire or centrally depressed or more commonly somewhat bilobed, in one species the sterile apex of style divided into two unequal erect attenuate lobes; on styles apically bilobed each stylar lobe bearing a subterminal stigma and each lobe terminated in a short rounded sterile apex; on styles having oblique stigmas the sterile apex of the style 2-parted, consisting of two paralleling, anterior-posteriorly prolonged ridges which are either low-convex and inconspicuous or are elevated and conspicuous and most prominent over the high anterior side of the stigmas; stigmas 2, subapical, vesicular, transversely very elongate, slightly sinuous, distinct or imperfectly united at the ends, usually arranged end to end around the style just below the sterile apex to form a slightly sinuous swollen vesicular band, rarely separated on short lobes of the style and remaining evidently distinct, usually horizontal, less commonly distinctly oblique and highest above the style-base on the abaxial side; nutlets 1-4 maturing, gray to reddish, geminate or all alike, verrucose, tuberculate or tumulose or (less commonly) nearly smooth especially below the middle, broadly lanceolate, ovate or cordate in dorsal outline, back convex or obtuse without a medio-longitudinal ridge or the latter rare and imperfectly developed, venter obtuse or medially carinate, the medial suture open to form a lineate or attenuate sulcus or, when closed, having the margins merely touching or very narrowly overlapping, the margins of the suture coalescent, if at all, only near the nutlet-apex; attachment of nutlet completely lateral and vertical or below the middle partially oblique and suprabaasal or rarely even partially basal, consisting of a lineate or a slenderly attenuate sulcus which extends upward along the vertical ventral keel usually almost to the nutlet-apex and downward into an abruptly expanded triangular or ovate areola, only in one species is the attachment a narrow lineate sulcus that is widely forked below the middle and equally wide for its entire length and nowhere expanded into an areola; the attachment-areola, frequently green and not uncommonly prominent, usually borne above the nutlet-base at the lower end of the ventral keel and usually in the same plane as the latter and hence, like the keel, usually vertical as well as distinctly lateral, much less commonly the areola is borne on the sloping inner side of the nutlet below the end of the ventral keel and hence oblique in its relation to the vertical keel, only in one species is the areola borne on the base of the nutlet and nearly horizontal.

As here defined, *Echiochilon* is amplified to include most of the species formerly referred to *Sericostoma*. These latter species have small, regular or only moderately irregular corollas. They differ from the older members of *Echiochilon* only in size of corolla and in degree of zygomorphy and are obviously very much more closely related to them than to the single original species of *Sericostoma* with which, until now, they have been unnaturally

associated. *Echiochilon* as redefined is distinguished from the monotypic *Sericostoma* by the form and position of the stigmas, the form of nutlet-attachment, form of gynobase, valvate rather than imbricate sepals, position of stamen-attachment, etc., characters certainly much more significant than those involving the relative size of corolla and the degree of zygomorphy which alone distinguished the two genera before redefinition.

The corollas of *Echiochilon* may have a pronounced bilateral symmetry or may show little or no departure from the radial symmetry that prevails in the flowers of most Boraginaceae. In four species of the genus, *E. longiflorum*, *E. lithospermoides*, *E. chazaliei*, and *E. fruticosum*, the corollas are very strongly zygomorphic, being conspicuously prolonged dorsally and having an excessively oblique limb. In all these species the stamens are affixed in three superposed levels within the irregular corolla. The most extreme zygomorphy is that of *E. longiflorum*. Whereas the other species have the forward (abaxial) lip of the corolla more or less evidently 3-lobed, *E. longiflorum* has only the two rear corolla lobes well developed, the forward lip of the corolla being represented only by an inconspicuous, narrow, recurving, unlobed margin.

In contrast to the four just discussed, such species as *E. collenettei*, *E. arenarium*, *E. jugatum*, *E. vatkei*, *E. albidum*, *E. nubicum*, *E. verrucosum*, and *E. thesingeri* have corollas that are actinomorphic or practically so. Among this group of species only *E. verrucosum* has stamens that arise at different levels within the corolla. All the others have stamens arising from the wall of the throat all at the same level above the corolla-base. Their flowers have radial symmetry, not only in form of corolla but also as to size and attachment of the members of the androecium.

The remaining species of *Echiochilon* have corollas transitional in various degrees between the strongly bilateral and the radially symmetric corollas just mentioned. The corollas of *E. kotschyi*, *E. strigosum*, *E. persicum*, and *E. arabicum* have only inconspicuously zygomorphic corollas. These deviate from radial symmetry only in having the two adaxial lobes somewhat larger and less spreading than the other three lobes. The stamens are borne on the corolla in three superposed levels in all four species. More pronounced zygomorphy is present in the corollas of *E. adenophorum*. In that species the corolla-limb is distinctly oblique, but not so extremely so as in *E. longiflorum* and its relatives. The two lobes of the adaxial lip are large and erect and evidently larger than the three spreading, evidently smaller lobes of the anterior lip. The stamens are affixed at unequal heights within the corolla-throat.

Past authors have repeatedly compared the irregular corollas of *Echiochilon* with those of *Echium* and, indeed, have frequently classified the two genera together because of their zygomorphy. Though the corollas in these genera are both irregular, they are organized with fundamentally different planes of symmetry, cf. Jour. Arn. Arb. 35: 165 (1954).

The orientation of the strongly zygomorphic corollas of *Echiochilon longiflorum*, *E. lithospermoides*, *E. chazaliei*, and *E. fruticosum* can be es-

established readily and with accuracy by reference to identifiable lobes of the calyx. In the species mentioned the calyx-lobes are extremely unequal with the shortest lobes always having the adaxial position and the largest lobe always being one of the two abaxial lobes. Following the system of numbering adopted by Eichler, the largest lobe is No. 1, the smallest lobe is No. 2 and lobe No. 3 is the companion of No. 1 on the abaxial side of the calyx. A close examination of the flower shows very clearly that the medial plane of symmetry in the flower passes through calyx-lobe No. 2 and between calyx-lobes Nos. 1 and 3, and also between the two rear (adaxial) corolla-lobes and through the middle lobe of the three-lobed forward lip of the corolla. The corolla of *Echiochilon* is not resupinate as in *Echium* cf. Jour. Arnold Arb. 34: 287 (1953), and its rear (adaxial) lip is bilobed rather than trilobed. The stamens, when borne at differing altitudes within the corolla, always have the odd, unpaired member borne on the adaxial side and always affixed higher above the corolla-base than the other four stamens. In *Echium*, although the stamens are also borne at unequal heights in the corolla-throat, the odd, unpaired stamen is borne not on the adaxial but on the abaxial side of the corolla and is the lowest rather than the highest of the five stamens. The differences between the corollas of *Echiochilon* and *Echium* are more significant than are the similarities. This is perhaps not surprising, for if one considers all characters in corolla, stamens, pollen, stigmas and nutlets, it seems impossible that the two genera could be immediately or even closely related.

Characteristic of the genus is 2-colpate, bilaterally symmetric pollen. This anomalous form of pollen has been observed in every species of the genus. Usually it is the only type of pollen produced, but in a few species it may be observed mixed in various proportions with 3-colpate pollen and even in mixtures in which the 3-colpate type may overwhelmingly predominate. Among the sixty-two samples of pollen studied, the largest quantity of 3-colpate grains has been observed in the samples representing *E. jugatum*, *E. persicum*, and *E. thesigeri*. Occasional 3-colpate grains were found intermixed with the almost exclusively 2-colpate pollen of *E. kotschyi* and *E. vatkei*. Only 2-colpate pollen was noted in the other species of the genus. Similar 2-colpate pollen occurs in *Sericostoma*, but is known from no other genus of the Boraginaceae.

The bicolpate bilaterally symmetric pollen of the genus is elliptic, rhombic-elliptic or nearly circular in polar profile. A slight prominence or roughening in the periphery usually marks clearly the location of the two colpi. The colpi are diametrically opposite when the silhouette is circular and usually located at the far ends when elliptic or rhombic. Only in the elongate grains of *E. lithospermoides*, *E. longiflorum*, and *E. fruticosum* are the colpi borne at the middle of the broad side and not at the far ends of the grains.

In lateral profile the grains are quadrate or rectangular and tend to be broader than high. The upper and lower edges in lateral profile are usually straight and parallel, which indicates that the grains are truncate and plane on top and bottom. The vertical edges of the quadrate or rectangular lat-

eral silhouette differ from the top and bottom edges in being very moderately but still distinctly convex. The two colpi are short, vertical and equatorial and are borne on opposite sides of the usually bilaterally symmetric grain.

The grain as a three-dimensional object can be described as subcylindric, flattened on the upper and lower ends and as broad as long or slightly broader than long. The grains are usually swollen laterally in the vicinity of the two colpi and, accordingly, are usually broader along the diameter connecting the two colpiferous faces than along the diameter between the non-colpiferous faces. Because of this, the polar profile of the grain may vary from nearly circular to elliptic or somewhat rhombic in outline. Furthermore, as a result of the described modifications the grains may lose their basic radial organization and assume a moderate but very definite bilateral symmetry.

The bilaterally symmetric bicolpate grains appear to be a modification of the tri-colpate. In polar profile the 3-colpate grains of *Echiochilon* may appear circular with the location of the colpi weakly marked on the periphery or it can be distinctly three-sided with the colpi evident on each of the three angles. In lateral outline the 3-colpate grains are transversely ovate or elliptic and are accordingly broader than high. The grain, as a three-dimensional figure, accordingly, is broader than high and is more or less convex on the upper and lower surfaces. The three colpi are vertical and equatorial. The pollen consists of three equivalent radial sectors. By the suppression of one of these sectors the bicolpate pollen of *Echiochilon* and *Sericostoma* has been formed.

The bicolpate grains in *Echiochilon* when expanded in lactic acid have quadrate or rectangular colpiferous faces, in most species, measuring 16–19 μ in width and 13–16 μ in height. The maximum size occurs in the grains of *E. chazaliei* in which the colpiferous face measures 22–24 μ wide and 18–21 μ high. In the small grains of *E. strigosum* the face is 15–16 μ wide and 13–15 μ high.

In polar profile the grains may be circular or nearly so and 14–16 μ in diameter or be elliptic or rhombic and measure 16–21 μ long and 14–16 μ wide. The grains of *E. chazaliei*, the largest in the genus, have a polar profile 24–28 μ long and 21–24 μ wide.

Tricolpate grains have the lateral silhouette transversely ovate or elliptic and measuring 16–19 μ wide and 13–16 μ high. The polar profile, three-sided or nearly circular, is 15–23 μ broad.

The stigmas of *Echiochilon* are unusual among the Boraginoideae, being transversely prolonged and usually forming a band about the style just below its apex. In *Sericostoma* the two stigmas are subglobose or short-oblong and as long as broad or longer than broad. They always project upward well above the sterile tip of the style. In *Echiochilon* the two stigmas are transversely elongate, being 3–6 times broader than long. The two stigmas usually have their ends touching and sometimes partially confluent. Together they form a narrow, usually slightly sinuous, pallid swollen vesicular band around the style just below its apex. These stigmas un-

questionably have a lateral and subapical position on the stylar column. The sterile apex of the style, in a variety of forms, is evidently prolonged above the stigmatic band. In one species the style is bilobed at the apex and a stigma partially encircles each of the short lobes just below the short, convex, sterile apex. The stigmas remain distinct.

In most of the small-flowered species (Nos. 8–17), the tip of the style is broad and low-convex and usually projects above the stigmas for a height equal to about half the width of the stigmatic band. This sterile summit may be simply convex or may be obscurely bilobed. In *E. collenettei*, the apex is most prolonged, being short-cylindric and entire, or sometimes bilobed. In *E. chazaliei* the apex is high convex, being at least hemispheric, and usually bears a small terminal depression at the very summit. In *E. arenarium* the stylar apex is divided into a pair of erect, usually very slightly unequal, attenuate lobes having a length equalling several times the width of the stigmatic ring. The elongate sterile tips of the style, prolonged well beyond the annular stigmas, combine in *E. arenarium* and *E. collenettei* to produce a structure very suggestive of the stigmatic head developed in *Heliotropium*. The condition has its closest parallel among the Boraginoideae in *Buglossoides*, cf. Jour. Arnold Arb. 35: 40 (1954) and 35: 161 (1954).

The style and stigmas of *E. longiflorum*, *E. lithospermoides* and *E. adenophorum* are the most specialized in the genus. The summit of the style, encircled by the stigmas, is enlarged, very oblique and bilaterally symmetric. The style just below its summit abruptly increases in diameter two- or rarely three-fold and is there encircled by the stigmas. The style with its abruptly thickened summit is somewhat suggestive of a nail with a broad head. The "head" of the style, however, differs from that of a nail in being oblique rather than horizontal. From the low rear (adaxial) margin its slope upward at an angle of 30°–60° towards the high forward (abaxial) margin. The band of stigmatic tissue on the margin of the "head" is also oblique. On the broad, decidedly sloping summit of the stylar head are borne a pair of sterile stylar apices of unusual form. Viewed from above the two apices are separate and parallel and lanceolate or ovate in outline. Together they are frequently very suggestive of the hoof of a goat. Viewed from the side they increase in height as they extend across the stylar head from the rear towards the forward margin. They are most conspicuous on the high forward side of the stylar head and broadest and tallest there. They are moderately developed in *E. adenophorum* and best developed in *E. longiflorum* and *E. lithospermoides*. These three species all have very strongly zygomorphic corollas. The asymmetric and oblique heads of the style, however, are not an invariable accompaniment of strong zygomorphy. Although the corolla of *E. chazaliei* is very oblique and zygomorphic, its style is not enlarged at the apex, its stigmas form a horizontal band, and the style has a simple, high-domed apex.

The style and stigmas of *E. fruticosum* have unique features. Differing from other species in the genus, *E. fruticosum* has a style which is distinctly bilobed. Each of the very short stout lobes is partially embraced

by a transversely elongate stigma borne laterally just beneath the rounded apex of the lobe. Separated on lobes of the style that tend to diverge in age, the stigmas of *E. fruticosum* remain evidently distinct and give no appearance of being joined to form a continuous stigmatic band entirely surrounding the style as do the stigmas in other species of the genus. They are somewhat suggestive of the stigmas in the genus *Sericostoma* but are borne lateral and subapical and not terminal on the style as in that genus.

The nutlets of most of the species of *Echiochilon* are broadly lanceolate to ovate in dorsal outline and most of them are rather plump. In many of the species they are paired, being bent either left or right, so that, of adjacent nutlets, one is the mirror image of the other.

The attachment of the nutlets is essentially lateral. The gynobase is usually about as long as the nutlet. The nutlet has its principal area of attachment in a broad, usually more or less triangular areola which is borne on the ventral side of the nutlet-base at the lower end of the vertical ventral keel, sometimes below and oblique to the keel but usually in the same plane as the keel. Only in *E. chazaliei* and *E. adenophorum* is the attachment-areola so excessively oblique as to become almost basal on the nutlet and even nearly horizontal. From the attachment-areola a linear or attenuate sulcus is usually prolonged up the center of the nutlet along the crest of the ventral angle of the nutlet. This sulcus is the open ventral suture of the nutlet. The margins of the suture are conerescent only near the nutlet apex. In most species the suture is open to well above the middle of the nutlet body and frequently open almost all the way to the nutlet apex. In a few species such as *E. chazaliei*, *E. adenophorum* and *E. arenarium*, however, it may be closed for much of its length, but closed only by having the margins of the suture merely touching or shortly overlapped, and very definitely not by the fusion of the margins.

The pit which represents the end of the broken funicular canal is located in the attachment areola, usually in or near the upper corner of the areola and consequently beneath the lower end of the ventral keel. The course of the canal as it leaves the nutlet is vertical and usually more or less in line with the crest of the ventral keel above it.

Only two species develop nutlets especially noteworthy as to form. The eastern variety of *E. fruticosum* has plump, lanceolate nutlets. In the typical phase of the species from North Africa, however, the nutlets are not straight, erect and lanceolate. They are bent and have their broad lower half diverging from the vertical ventral sulcus and the gynobase at an angle of almost 90°. The back of the nutlet is incurved and saddle-like in lateral outline. I know of no other borage having nutlets which are bent 90° at the middle and which have the upper half vertical and affixed to the slender gynobase while the lower half is spreading and divergent from the floral axis. Bent nutlets occur in the Lithospermeae, cf. Jour. Arnold Arb. 35: 161 (1954), but among these plants it is the lower half of the nutlet which is vertical. Furthermore, the bending of the nutlet in the Lithospermeae is inward over the floral axis and not outward and away from it as in *E. fruticosum*.

The nutlet of *E. longiflorum* has a number of unusual features. The broad base of the nutlet is shortly bilobed, has a deep medial sinus and is definitely cordate in outline. The nutlets viewed dorsally are decidedly heart-shaped. So deep is the basal sinus that the seed inside the nutlet has bilobed cotyledons. The broad nutlet has no large attachment-areola. It is attached to the slender erect gynobase only along a lineate sulcus. This groove, an open suture, extends down the vertical ventral keel to above the sinus on the nutlet-base where it abruptly and widely forks. The branches of the sulcus are at first divaricate but promptly decurve on the oblique lower surfaces of the nutlet venter and finally end low down on the oblique side of the two basal lobes of the nutlet. In most species of the genus the nutlet-areole is attached in the angle at the base of the gynobase between the wings buttressing the base. In *E. longiflorum*, however, the attachment sulcus is affixed to the sides of the subulate gynobase and, below the fork, along the crests of the buttressing wings and not at all in the angle between them.

KEY TO THE SPECIES OF ECHIOCHILON

- Corolla glabrous on outer surface; foliage tending to be succulent and glaucescent.
 - Plant annual; nutlets cordate, having a pronounced basal sinus. 1. *E. longiflorum*.
 - Plants perennial, frutescent; nutlets ovoid, not cordate.
 - Leaves, bracts and calyx-lobes with a midrib; leaves lanceolate, apex attenuate, margin hispid-ciliate; stigmas decidedly oblique, surmounted by a bilobed tip of the style. 2. *E. lithospermoides*.
 - Leaves, bracts and calyx-lobes not costate; leaves thick, obovate to spatulate, apex obtuse or rounded, margins not ciliate; stigmas horizontal, surrounding the domed sterile apex of the style. 3. *E. chazaliei*.
- Corolla evidently hairy outside or bearing minute stipitate glands.
 - Herbage bearing abundant minute stipitate glands; corolla glanduliferous outside, not hairy.
 - Corolla zygomorphic, limb oblique and bilabiate, filaments borne at unequal heights in the corolla-throat; stigmas very oblique, sterile tip of style inconspicuous, extremely short; nutlets with basal and horizontal attachment-scar. 4. *E. adenophorum*.
 - Corolla regular, limb not oblique, filaments all arising at the same distance above the corolla-base; stigmas horizontal, surmounted by the evident, somewhat cylindric sterile tip of the style; nutlets with the attachment-scar distinctly lateral and vertical. 5. *E. collenettei*.
 - Herbage not distinctly glanduliferous; corolla villulose or strigulose outside, not glanduliferous.
 - Calyx-lobes conspicuously unequal in length, commonly with blue margins; corolla 8–12 mm. long, strongly zygomorphic with a conspicuously oblique limb; style 2.5–3.5 mm. long; stigmas distinctly oblique; North Africa, Sinai and Palestine. 6. *E. fruticosum*.

Calyx-lobes equal in length or practically so, without colored margins; corolla 3–6 mm. long, radially symmetric or only very moderately zygomorphic, limb not at all oblique or only very moderately so; stigmas horizontal or somewhat oblique only in No. 7.

Style 1–3.5 mm. long, terminated in a pair of subulate sterile tips 0.2–0.5 mm. long; calyx with lobes united at the base into a short tube; coast of Italian Somaliland. 7. *E. arenarium*.

Style 0.5–1.5 mm. long, abruptly contracted into a very short broad usually merely convex sterile tip barely surpassing the stigmas; calyx-lobes not united into a short tube.

Flowers borne along the leafy stems interspersed among developed leaves, the inflorescence hence interrupted, not distinctly racemose nor unilateral.

Leaves all opposite, only the bracts alternate and these usually opposing a flower; plant silvery strigose, and indument smooth and dense; corolla 5–6 mm. long, regular; eastern and southern Arabia. 8. *E. jugatum*.

Leaves mostly alternate, only the several lowermost pairs of leaves on the shoot opposite.

Plant generously strigose, whitish or gray; corolla 5.5–6 mm. long, zygomorphic, the 2 adaxial lobes prolonged, the limb somewhat oblique and the filaments affixed at unequal heights on the corolla; style 1.5–1.7 mm. long; nutlets obscurely roughened or nearly smooth; islands of the Persian Gulf. 9. *E. kotschyi*.

Plant with sparse appressed grayish hairs, greenish; corolla 3.5–4 mm. long, the limb regular and the filaments affixed at equal heights on the corolla; style 0.5–0.7 mm. long; nutlets prominently and densely verrucose; eastern British Somaliland. 10. *E. vatkei*.

Flowers borne in elongating unilateral racemose cymes; inflorescence terminating the leafy twig, bearing small bracts but not interrupted by well developed leaves.

Leaves lustrous, white, densely clad with abundant appressed snowy or silvery white hairs; northeastern Somaliland. 11. *E. albidum*.

Leaves greenish or cinereous, if distinctly pallid not clad in abundant lustrous white hairs.

Corolla distinctly prolonged on the adaxial side, the axial pair of lobes largest and the limb oblique.

Leaves small (1–6 mm. long, 0.5–1 mm. broad), becoming recurved; corolla small, 3–4 mm. long; southern Arabia. 12. *E. strigosum*.

Leaves larger (3–15 mm. long, 1–3 mm. broad), spreading or ascending.

Plant pallid, clothed with abundant appressed white or gray hairs; corolla 4.5–6 mm. long; southern Iran and Baluchistan. 13. *E. persicum*.

- Plant greenish, clothed with fewer hairs and usually hispid; corolla 5–8 mm. long; southern Arabia and middle northern British Somaliland. 14. *E. arabicum*.
- Corolla not prolonged on adaxial side or at most only very obscurely so; corolla limb not oblique and the lobes equal or nearly so.
- Plant whitish, densely clad with pallid hairs; calyx at anthesis 2–2.5 mm. long, sessile or subsessile at maturity; style very short 0.5–0.8 mm. long; Sudan coast of Red Sea. 15. *E. nubicum*.
- Plant grayish green, only moderately hairy; calyx at anthesis 2.5–3 mm. long, developing a stout strict pedicel 0.5–1.5 mm. long at maturity; style 1–1.4 mm. long.
- Filaments arising from the corolla at unequal distances above the corolla-base; western Brit. Somaliland. 16. *E. verrucosum*.
- Filaments within the corolla all arising at the same distance above the corolla-base; eastern and southern Arabia. 17. *E. thesigeri*.

1. *Echiochilon longiflorum* Benth. in Hook. Icones Pl. 13: 60, *t.* 1277 (1879) — near Aden, *Wykeham Perry*.

Lobostemon somalensis Franchet, Sert. Somal. 44 (1882) — pays des Comalis, *George Revoil* 78.
Leurocline somalensis (Franch.) S. Moore, Jour. Bot. 39: 258 (1901).
Echiochilon somalense (Franch.) Johnston, Contr. Gray Herb. 73: 50 (1924).

Annual herb, erect with ascending branches, glaucous, 5–40 cm. tall; cotyledons persisting (sometimes even on the flowering plant), 6–10 mm. long, from a slender petiole 3–5 mm. long expanding into a blade 4–7 mm. wide, coarsely and conspicuously emarginate at apex, the terminal sinus 1–2 mm. deep and usually as broad, usually rounded at the base; leaves alternate or only the lowermost opposite, somewhat succulent, lanceolate, usually acute, 1–4 cm. long, 2–6 mm. broad, upper surface glabrous, lower surface bearing scattered coarse mineralized disks from which may arise short usually appressed hairs, midrib usually evident on lower surface; stems and branches terminating into elongate unilateral racemose cymes; cymes not at all scorpioid, erect, many-flowered; bracts numerous, foliaceous, gradually reduced in size upwards along the cyme; calyx with very unequal lobes, at anthesis 4–6 mm. long, borne on a pedicel 1–3 mm. long, smallest lobe adaxial, linear, 1.5–2 mm. long, 0.2–0.5 mm. wide, largest lobe abaxial 5–6 mm. long, 1–2 mm. broad; corolla lilac or pale blue, glabrous, texture not firm, 12–18 mm. long, densely white villose inside throat; limb of corolla very oblique ca. 10 mm. long, the adaxial lip prolonged, loosely recurving above the middle, its lobes 2–2.5 mm. long, the three abaxial lobes small, crowded to form the poorly developed weakly 3-lobed recurving abaxial lip of the corolla; corolla-tube 4.5–5.5 mm. long, broadest (ca. 1.3 mm. thick) 1–1.5 mm. above the base, at summit ex-

panding into an evident funnellform oblique throat which is 2–3.5 mm. thick; stamens borne at base of throat just above the narrowest part of the tube, with filaments of unequal lengths and affixed at unequal heights above the corolla-base; anthers 0.8–1 mm. long; adaxial medial filament as much as 0.8 mm. long and borne 7 mm. above corolla-base; abaxial pair of stamens with filaments 0.2 mm. long and affixed 5.5 mm. above corolla-base; lateral stamens with filaments 0.7–0.8 mm. long and affixed 6 mm. above base of corolla; gynobase with a small horizontal base (1–1.3 mm. wide) from the center of which arises a slender 4-sided vertical upward prolongation ca. 2.5 mm. long and ca. 0.25 mm. thick, terminated by a style 4–5 mm. long; stigmas strongly oblique, highest on abaxial side, surmounted by 2 prominent sterile terminal lobes (0.1–0.2 mm. long) of the style; nutlets 2.3–3 mm. long, reddish to gray-brown, usually four developing, 1.8–2 mm. broad just above the base, verrucose or irregularly tuberculate, the base broad, deeply and conspicuously cordate, the apex coarsely rostrate, venter evidently sulcate, the groove extending down from near the nutlet-tip almost to the nutlet-base, lateral and vertical, above the base very widely forked and oblique on the basal lobes of the nutlet.

ADEN: Aden, received Aug. 1900, *Dr. T. Cooke*, (K); "Aden or Perim," *J. V. Lester-Garland* (K); Aden, Feb. 19, 1900, *W. S. Birdwood* (K); Aden, 1884, *H. R. Beevor* 103 (K); Aden, only one specimen found, ca. 1 ft. tall, corolla light blue, stems and branches smooth, March 1878, *W. Wykeham Perry* 9 (Type of *E. longiflorum*, Kew).

SOMALILAND: Wardere Well, 6–10 in. tall, fl. lilac, Nov. 23, 1944, "Kabaageye," *Glover & Gilliland* 302 (K); Dubriat Mt., lat. 10°22'N., long. 45°10'E., throat and tube of corolla bright pale blue, limb pale lilac, bed of torrent, limestone, 700 ft. alt., Jan. 3, 1933, *J. B. Gillett* 4787 (K); Djibouti, 1895, *Dr. Jousseume* (P); pays des Çomalis, *Geo. Revoil* 78 (Type of *L. somalensis*, Paris).

Distinguished from all other members of the genus both by its annual habit and its cordate nutlets. The nutlets of *E. longiflorum* constitute one of the bizarre extreme variants of the boraginaceous fruit. As to their cordate body, they have a parallel only in the fruit of the unrelated *Arnebia tetrastigma* Forsk. The closest relation of our species, however, appears to be with *E. lithospermoides*. Interestingly, in that species the base of the nutlets may be obscurely depressed and hence is suggestive of an incipient state of a type of variation that could be elaborated to form a deep basal sinus such as is present on the nutlets of *E. longiflorum*. I have seen both the type of *E. longiflorum* and of *Lobostemon somalensis*. They are representative of the same species without doubt. The plant is a desert annual which is not only rare but also one that has been encountered only in very limited quantity.

2. *Echiochilon lithospermoides* (S. Moore) Johnston, *Contr. Gray Herb.* 73: 50 (1924).

Leurocline lithospermoides S. Moore, Jour. Bot. 39: 257, t. 424, f. 1 (1901) — Brit. East Africa: Leikipia, June 1893, J. W. Gregory; Gof at 3800 ft. and between Lé and Tocha, 1898, Lord Delamere.

Lobostemon lithospermoides (S. Moore) Baker, Fl. Trop. Africa 4²: 60 (1905).

Plant suffrutescent, perennial, 1–4 dm. tall, freely and ascendingly branched; stems 1–10 dm. long, becoming shrubby and decumbent in age; herbage glaucous; leaves lanceolate, 1–3 cm. long, 2–5 mm. wide, broadest above the sessile base and gradually narrowed to the sharply acute or acuminate apex, upper surface usually glabrous, lower surface with mineralized pustules or short stout spreading hairs arising from bulbous bases, usually more or less evidently costate, margin usually coarsely hispid-ciliate; inflorescence an erect unilateral racemose cyme, elongating in age, 1–3 dm. long, 10–50-flowered, terminating the stem and branches, bracts numerous, evident, foliose, lowermost similar to the uppermost leaves, very gradually reduced upward along the cyme; calyx subsessile or in age with strict pedicel 1–2 mm. long, with very unequal lobes; lobes distinct, hispid-ciliate, largest lobe abaxial, lanceolate, attenuate, ca. 8 mm. long and ca. 1.3 mm. broad above the base, becoming twice as large and costate at maturity; smallest lobe adaxial, ca. 4 mm. long and 0.4–0.5 mm. broad, twice as large at maturity; inner surface of calyx lobes glabrous, outer surface pustulate or bearing some stout hairs arising from bulbous bases; corolla reddish purple, 12–15 mm. long, strongly zygomorphic, glabrous outside, below the middle tubular and above the middle expanding into an extremely oblique funnelform throat and limb; corolla-tube usually ca. 2 mm. in diameter at the very base, constricted (to 1.3–1.5 mm. thick) 4.5–6 mm. above the base and then expanding into the throat; limb 7–9 mm. in diameter; corolla-lobes rounded, the two adaxial lobes vertical, erect, 2.5 mm. broad, the three other lobes less well developed, the single anterior lobe horizontal; inside of corolla densely villulose in a zone usually extending from 4 to 6.5 mm. above the corolla base, hairs 0.2–0.3 mm. long, white or slightly yellowish; inside of corolla-throat bearing only scattered hairs which may be 0.3–0.4 mm. long, base of tube without annulus and glabrous; anthers 1–1.3 mm. long, elongate, slightly arcuate, emarginate at base, borne at unequal heights just above the narrowest part of the corolla at the base of the throat; adaxial anther borne on a filament 0.6–0.7 mm. long arising ca. 6.5 mm. above the corolla-base; adaxial lateral pair of anthers borne on filaments 0.3–0.4 mm. long arising ca. 5.5 mm. above corolla-base; abaxial pairs of anthers borne on filaments 0.2–0.3 mm. long arising only 5 mm. above corolla-base; gynobase at maturity 1.5–2 mm. tall, pyramidal, 1–1.3 mm. broad at base, sides usually excavated; style 3–4 mm. long at anthesis, stigmas oblique, surmounted by 2 laterally compressed sterile tips of the style which are usually most prominent on the high abaxial side of the stigma; nutlets 1–4 developing, 2–2.4 mm. long and nearly as broad, plump, reddish, back usually tuberculate and more or less tumulose, venter angulate, bearing a triangular areole (ca. 1 mm.

wide) which contracts into a linear or (more commonly) attenuate sulcus that extends upward almost to the nutlet-apex; areola ventral, usually with prominent scar-tissue, more or less oblique.

KENYA: Banaisa, North Frontier dist., fl. red, June 27, 1951, *Kirrika* 92 (G, K); Rumuruti, K. 3, *Coryndon* 6865 (K); Rumuruti, northeast slope of Aberdares, 7000 ft. alt., fl. pink or red, *W. J. Dowson* 551, 554 (K); Rumuruti, common locally, grassland with scattered trees, Aug. 12, 1952, *Bogdan* 3519 (K); 50 miles southeast of Nairobi, dry soil in shade, fl. "aster purple," leaves "bice green," 5000–7000 ft. alt., July 13, 1923, *A. G. Curtis* 757 (G); Mile 20, between Laitokitak and Kijiado, N. Kilimanjaro, tufted grassland, shallow red soil above limestone, plant tufted, about 2 ft. tall and 2 ft. in diameter, Sept. 1952, *P. R. O. Bally* 8323 (K, Fl).

ETHIOPIA (Boran): Road between Moyale and Mega, 30°44'N, 38°50'E, open scrub in red sandy loam, spreading shrublet 40 cm. tall, corolla reddish purple fading to blue-purple, 4200 ft. alt., Nov. 10, 1952, *J. B. Gillett* 14191 (G, K); in deserto Banas, July 14, 1893, *Ruspoli & Riva* 1634 (882) (Fl); between Mega and Malca Guba, April 26, 1939, *R. Corradi* 6206 (Fl); Mega, April and Sept. 1939, *R. Corradi* 6389, 6399, 6401 (Fl); Javello diclivi de Quota Littorio, fl. atropurpurei, April 18, 1937, *G. Cufodontis* 479 (Fl); Foresta de Neghelli, Aug. 23, 1937, *A. Vàtova* 231 (Fl); Foresta di Neghelli, Sept. 27, 1939, *R. Corradi* 8237 (Fl); Neghelli, Sept. 10–29, 1939, *R. Corradi* 6230, 6284 (Fl).

A plant of desert grasslands which ranges from southern Ethiopia south through northern and eastern Kenya. It is known from a few stations south of the equator and accordingly is the most southerly ranging member of its genus. The species is readily recognizable and very distinct. It appears to have close relations only with *E. chazaliei* and *E. longiflorum*. In having relatively large, plump, dark reddish nutlets and sharply acute or acuminate, usually costate, leaves, bracts, and calyx-lobes, it is distinguishable from all other members of the genus.

3. *Echiochilon chazaliei* (Boiss.) Johnston, Contr. Gray Herb. 73: 50 (1924).

Lithospermum chazaliei Boiss. Jour. de Bot. 10: 220 (1896) — Cape Blanc, May 1895, *M. de Dalmas*.

Leurocline chazaliei (Boiss.) Bonnet, Bull. Soc. Bot. France 58: 38 (1911).

Leurocline mauritanica Bonnet, Bull. Mus. Hist. Nat. Paris 14: 403 (1908) — near Port Etienne, 1908, *R. Chudeau*.

Echiochilopsis coerulea A. Caballero, Trab. Mus. Nac. Cien. Nat. Madrid, Bot. 30: 10, t. 2 (1935) — inter ora fl. *Tazarut* et promintorio *Non* dictis, July 11, 1934, et ad oram fl. *Assaka* dicto, July 13, 1934, *Caballero*.

Plant fruticose, perennial; stems 5–35 cm. long, erect or ascending or decumbent, loosely and dichotomously branched, 1–5 mm. thick, sparsely strigose or nearly glabrous, in age albescent and eventually decortivating; leaves mostly alternate, only the lowest ones on the shoot opposite, oblanceolate or oblance-obovate, fleshy, glaucous, bearing scattered coarse short appressed hairs arising from discoid bases, 4–18 mm. long, 2–5 mm. broad,

apex rounded, base cuneate, without evident midrib or nerves; cymes 3–8-flowered, leafy bracted, erect, terminating the leafy branches; calyx 5-parted, 6–8 mm. long at anthesis, becoming 8–15 mm. long at maturity; calyx-lobes extremely unequal, oblong or oblanceolate, not costate, bearing scattered appressed hairs with discoid bases, tip rounded; smallest calyx lobe adaxial, 2–4 mm. long, ca. 0.5 mm. broad, largest lobes abaxial 7–13 mm. long, 1–2.5 mm. broad; pedicel stout, 1–4 mm. long; corolla violaceous or mauve, outside glabrous, 11–21 mm. long, limb very strongly oblique, 10–20 mm. long, margin frequently crisped, two rear corolla-lobes erect 3–5 mm. long and 2.5–5.5 mm. broad, forward middle lobe 2.5–5.5 mm. long and 2.5–5 mm. broad, throat oblique, narrowly funnelform, corolla-tube 6–8 mm. long 2.5–3 mm. thick, inside densely hairy above the middle, hairs in the tube and throat white; anthers 1.2–1.5 mm. long; filament of medial adaxial stamen 1.4 mm. long, affixed 6–8 mm. above corolla-base, filaments of dorsal lateral stamens 0.8–1 mm. long, affixed 5–6 mm. above corolla-base, filament of forward lateral stamens 0.8–1 mm. long affixed 4–4.5 mm. above base of corolla; gynobase very narrowly pyramidal, 3–3.5 mm. long, ca. 1 mm. thick at base; style 3–5 mm. long, sterile apex domed, high convex with a central depression, not oblique, surrounded at the base by the horizontal stigmatic band; nutlets 1–4 maturing, gray, erect, acute, 3–4 mm. long, 2–2.5 mm. broad, dorsum convex sparsely tuberculate or tumulose or somewhat lobulate-tuberculate, especially above the middle, venter obtuse, for most of its length bearing a lineate groove, attachment-areole basal, very broadly flabelliform, horizontal or oblique, its ventral angle prolonged to form a lineate sulcus which extends upward nearly to the nutlet-apex.

SPANISH SAHARA: Aguerguer, north of Cape Blanc, Jan. 22, 1937, *Murat 1907* (G); between mouth of Rio Tazarut and Cabo Non, July 11, 1934, *Caballero* (G, Isotype of *E. coerulea*). MOROCCO: falaises du littoral de l'Océan à l'embouchure de l'Oued Aourioua, lat. 28°50'N, March 31, 1937, *Maire* (G).

Known only from northwestern Africa where it occurs on dunes along the coast, between lat. 20° and 30°N, in Ifni, in extreme southwestern Morocco, in Spanish Sahara and in that part of Mauritania near Port Etienne. It is the most westerly ranging member of its genus. The species is a very distinct one. The closest relation is *E. lithospermoides* of east Africa. Unlike other congeners having a strongly zygomorphic corolla with an oblique limb, *E. chazaliei* has horizontal rather than oblique stigmas. The nutlets of our species are roughened principally on the back above the middle with tuberculations and papillae of unusual form. These latter are strict and have a decurrent base. A new description and illustration of the plant has been recently published by Sauvage & Vindt, *Fl. du Maroc* 2: 116, *f. 2460* (1954). It is to be noted that the species is named not for its collector but for the yacht *Chazalie*, owned by the collector, the Count de Dalmas.

4. *Echiochilon adenophorum*, sp. nov.

Planta fruticosa 1–3 dm. alta laxè ramosa; ramis vetustioribus cortice alba decorticanti donatis; ramulis hornotinis foliosis 4–6 cm. longis 1–2 mm. crassis; internodiis 1–5 mm. longis; foliis ascendentibus alternatis (vel solum imam ad basim ramuli oppositis) glandulas minutas stipitatas abundantis proferentibus lineari-oblanceolatis laxè valdeque involutis ergo saepe plus minusve teretibus 10–25 mm. longis 1–2 mm. crassis, facie interiore glabris, facie exteriorè glanduliferis sparse hispidulis (pilis rigidis 0.5–0.8 mm. longis ascendentibus vel appressis basibus discoideis praeditis); inflorescentia racemosa 5–15-flora 3–5 cm. longa; floribus congestis biseriatis bracteatis; calyce subanthesi 4 mm. longo, maturitate accrescenti 5–6 mm. longo, lobis acutis valde inaequalibus, maturitate margine incrassato et costa plus minusve incrassata donatis; pedicello 1–2 mm. longo; corolla alba elongata 10–13 mm. longa extus sparse glandulifera, tubo 5–6 mm. longo a basi imò 1–1.5 mm. crasso sursum ampliato, 1–1.5 mm. supra basim crassissime (1.7–2 mm.) deinde sursum gradatim contracto, summum ad apicem 1 mm. crasso; faucibus infundibuliformibus 4–5 mm. longis margine superiore satis obliquis 3.5–4 mm. diametro, intus pilis albis vestitis; lobis inaequalibus integris rotundis, duobus adaxialibus erectis 1.8 mm. longis late ovatis, tribus anterioribus patentibus 1 mm. longis 1.5–1.8 mm. latis; antheris ca. 1.8 mm. longis inclusis; filamentis 0.1–0.2 mm. longis aequilongis; filamento postico ca. 6.5 mm. supra basim corollae affixo; filamento duobus anticis ca. 5.5 mm. supra basim corollae affixis; filamentis duobus lateralibus intermediis 6 mm. supra basim affixis; gynobasi 1.5–1.7 mm. alto a basi 1 mm. lato sursum abruptè attenuato; stylo 4–5 mm. longo supra stigmata valde obliqua apicibus sterilibus inconspicuis latis sed perbrevibus donato; nuculis saepe solum 1–2 maturantibus erectis vel parce incurvatis ca. 2 mm. longis et 1.4 mm. latis pallide rubescentibus vetustioribus plus minusve cinereis, supra medium crasse rostratis, infra medium satis compressis, dorse supra medium evidenter tuberculatis et tumulosis, infra medium conspicue laevioribus inconspicue tuberculatis et tumulosis subplanis; ventre nuculae late obtuso sulcum lineatum angustum medio-longitudinalem haud crassi-marginatum proferenti; cicatrice nuculae basali fere horizontali 1 mm. lata.

BRITISH SOMALILAND: rocky slopes of Goldither at 400 ft., behind Karin near Berbera, Berbera District, limestone, woody herb up to 1 ft., "sintar," April 24, 1945, *P. E. Glover & H. B. Gilliland 1181* (Type, Brit. Mus.; Isotype, Kew).

A very distinct species which is notable for its elongate, very strongly involute leaves, its glanduliferous herbage and its elongate, moderately but distinctly zygomorphic corollas. Along with *E. collenettei*, the species seems transitional between the group of species with very strongly zygomorphic, extremely oblique, usually elongate corollas and that with short, inconspicuously oblique, or more or less perfectly symmetric, relatively short corollas. In *E. adenophorum* the summit of the throat is less than 1 mm. longer on the adaxial side than on its forward side. The throat, ac-

cordingly, is very much less oblique than in the corollas of such species as *E. longiflorum*, *E. lithospermoides*, *E. chazaliei* and *E. fruticosum*. Externally the zygomorphy in our plant is manifest most by the dorsal swelling of the throat and in the enlargement of the two adaxial lobes.

Though certainly very distinct, *E. adenophorum* appears to be most closely related to *E. collenettei*. It differs from the latter species in having strongly involute leaves which are usually terete and have the upper leaf-surface completely hidden by the inrolled margins of the leaves. The corolla of *E. adenophorum* also differs in being glanduliferous but not hairy outside and in being distinctly zygomorphic with the limb oblique, the corolla lobes unequal and the stamens affixed at unequal heights in the throat. The style also differs in having very poorly developed sterile tips surmounting the very strongly oblique stigmas. The nutlets differ also in being basifixed.

According to the label, the plant is said to come from "Karin near Berbera." Perhaps Karin or Karrin on the coast 100 km. east of Berbera is intended, being designated as "near Berbera" to distinguish it from Karin or Carin, a well-known locality just east of the eastern boundary of British Somaliland, which is located nearly 500 km. east of Berbera.

5. *Echiochilon collenettei*, sp. nov.

Planta frutescens ascendenter ramosa 25 cm. alta; ramis annotinis albis vetustioribus decorticatis; ramulis hornotinis 0.5–1.5 mm. crassis foliis congestis ascendentibus vestitis; foliis alternis crassiusculis 5–10 mm. longis 0.8–1.2 mm. latis oblanceolatis haud costatis subplanis vel satis conduplicatis utrinque glandulas stipitatas abundantis gerentibus, subtus basim versus cuticula calcarea alba donatis alibi pilos rigidos e basi discoideo erumpentis 0.5–0.9 mm. longos haud abundantis ascendentis vel appressos gerentibus; inflorescentia pauciflora, floribus 1–5 apicem versus ramulorum inter folia gestis; calyce sub anthesi 4.5 mm. longo mox 6 mm. longo, lobis subaequalibus 1–1.5 mm. latis glanduliferis pilos paucos e basi discoideo erumpentibus proferentibus vetuste costatis; corolla alba elongata sub hypocrateriformi 13–15 mm. longa radialiter symmetrica, tubo 5–6 mm. longo extus glandulifero intus fere ad basim minutissime villuloso, faucibus infundibuliformibus 5–6 mm. longis ca. 3 mm. crassis intus flavo-villosis, limbo horizontaliter patenti haud obliquo, lobis subhomomorphis triangulari-ovatis 2–3 mm. longis utrinque albo-villulosis margine crispatis; antheris 1.2–1.4 mm. longis; filamentis aequalibus 0.1–0.2 mm. longis 7.5–8 mm. supra basim corollae affixis; gynobasi pyramidalis 1.1–1.5 mm. alta basi 1.1–1.3 mm. lato; stylo 3.5–4.5 mm. longo supra stigmata horizontalia apicem sterilem breviter cylindraceum truncatum vel plus minusve bilobatum 0.1–0.2 mm. longum 0.1–0.15 mm. crassum gerente, nuculis verrucosis 2 mm. longis 1.5 mm. latis dorse convexis ventre obtusis carinatis, cicatrice laterali verticali triangulari ca. 0.6 mm. lata prominenti sursum in sulcum crasse marginatum attenuatum abrupte producta.

ITALIAN SOMALILAND: Karin, lat. $10^{\circ}57'N.$, long. $49^{\circ}24'E.$, stony ground in dry stream bed, 900 ft. alt., plant 9 in. tall, fl. white, scarce, Oct. 29, 1929, C. N. Collenette 196 (Type, Kew).

This very well-marked species is known only from a single collection originating in northernmost Italian Somaliland just east of the British Somaliland boundary, cf. Collenette, Kew Bull. 1931: 403, 410 (1931). Unhappily, only a single corolla has been available for dissection. The stamens are borne on filaments of equal length which are all affixed at the same distance above the corolla-base. The corolla is regular or practically so, at most having the lobes differing very slightly in size. The relationships of the plant are probably closest with the very distinct *E. adenophorum* of northern middle British Somaliland. Both species have glanduliferous herbage and an elongate, somewhat trumpet-shaped corolla. Our plant differs, however, in having regular, non-zygomorphic corollas, as well as stouter, more plump nutlets, a lateral rather than basal nutlet-attachment, nearly equal calyx-lobes, smaller, nearly flat leaves, etc. The nutlets are very similar to those of *E. verrucosum*.

6. *Echiochilon fruticosum* Desf. Fl. Atlant. 1: 167, t. 47 (1798) — habitat prope Kerwan in regno Tunetano.

Echiochilon fruticosum var. *marginatum* F. Buxb. Verhandl. Zoo.-Bot. Ges. Wien 76: 61 (1927) — Ain Ghraesia, Tunisia, 1913, Janchen & Vierhapper.

Plant fruticose, pale; stems slender, decumbent, loosely branched, leafy branchlets 1–2 mm. thick, bearing appressed hairs ca. 0.5 mm. long; leaves all cauline, numerous, lanceolate, small, 2–10 mm. long and 0.5–2 mm. broad, acute, lacking evident midrib or veins, bearing appressed hairs on both surfaces; lowermost leaves opposite; cymes racemose, slender, erect, not at all scorpioid, 5–15 cm. long; bracts numerous, foliaceous, frequently with blue margins; calyx 4.5–5 mm. long, subsessile; calyx-lobes very unequal, lanceolate, frequently with blue margins, shortest lobe adaxial, 2–3.5 mm. long and 0.5 mm. wide, largest lobe 3.5–4.5 mm. long and 1 mm. wide; corolla blue, strongly zygomorphic, 8–12 mm. long, conspicuously hairy outside; limb very oblique, 8–10 mm. long and 4–6 mm. broad, with a spreading crisped margin 1–2 mm. wide, upper adaxial end of limb evidently 2-lobed (lobes erect 1.5–2.5 mm. long and broad) but less evidently lobed on the lower abaxial lip; tube and throat together 4.5–6 mm. long, 0.8–1 mm. thick at base, ampliate upwards and becoming 1.5–1.8 mm. thick (1–1.5 mm. above base of tube) and then constricted to 0.9–1.3 mm. thick (at 2.5–3 mm. above base) and finally swelling to 2.3 mm. (at 4–4.5 mm. above the base) at the level of the base of the forward corolla-lip; inside of corolla with an abundance of white or gray hairs just above the constriction of the corolla-tube, sparingly hairy in the throat and on the limb; anthers 1–1.2 mm. long; adaxial filament longest and borne highest in the throat, 0.4–0.6 mm. long, affixed 4.5 mm. above corolla-base; adaxial lateral pair of filaments borne 0.3–0.5 mm. below upper filament, 0.1–0.3

mm. long; forward pair of filaments borne 3.5–4 mm. above corolla-base, 0.1 mm. long; gynobase ca. 1 mm. tall, pyramidal below the middle and attenuate above the middle, terminated by a style 2.5–3.5 mm. long; style shortly bilobed at the apex, each lobe bearing a subterminal stigma; stigmas somewhat oblique, most prolonged on abaxial side, at anthesis closely juxtaposed and apparently united, in age the short lobes of the style tending to spread and the stigmas to separate, sterile tips of the stylelobes broad convex, scarcely surpassing the stigma; nutlets cinereous or pinkish and frequently somewhat mottled with brown, somewhat verrucose or tumulose, 1.6 mm. long, 1.2 mm. broad, bent near the middle with the beaked upper half erect and paralleling the ventral keel and the broad rounded lower half horizontal and diverging from the ventral keel at an angle of about 90° , ventral edge of nutlet angulate, nearly straight and vertical, dorsal side of nutlet saddle-like, base of nutlet strongly constricted and substipitate bearing an oblique open more or less triangular areola ca. 0.5 mm. broad, areola apically constricted and prolonged as a narrow groove to about the middle of the prominent ventral keel.

Ranging in the deserts from eastern Morocco eastward into Egypt.

ALGERIA: Beni-Mora à Biskra, *C. Schmitt* 165 (G); environs d'Aïn-Sefra-Oranais, May 30, 1934, *Faure* (G). TUNISIA: Zarzis, May 1884, *Letourneux* (G); Oued Chaffar entre Ifax et Gafsa, 1904, *Romieux* 122 (G); Gabes (Kauzeria), in desertis, *Petard* 197 (G). TRIPOLITANIA: Souk-el-Djemâa, 1939, *Maire & Weiller* 1054 (G); Tripoli in sand near Tadjura, *Bornmüller* 824 (G); ad Sabratha, *Bornmüller* 823 (G); Tripoli near Gargaresik, *Bornmüller* 922 and 8246 (G). EGYPT: near Alexandria, Ramleh, *H. A. Hurst* (K).

6a. *Echiochilon fruticosum* var. *sieberi*, nom. nov.

Lithospermum divaricatum Sieber ex. Spreng. Syst. 1: 543 (1825) — Ascalona, Palestine, *Sieber*.

Nutlets lance-ovoid, about twice as long as broad, 2–2.2 mm. long, 1–1.3 mm. thick, broadest above the rounded base and gradually narrowed towards the apex, back not saddle-like, venter angulate, nearly straight, vertical, bearing an ovate-lanceolate areola ca. 0.5 mm. broad on the ventral side of the rounded base, the apex of the areola gradually narrowing and prolonged upward along the ventral angle to above the middle of the nutlet.

Known only from Sinai, Palestine and Lebanon, on sands near the coast.

LEBANON: Jaffa, sables maritimes, Nov. 1832, *Bové* 224 (K), 428 (G, K); ISRAEL: Khan-Yunis, March 12, 1926, *S. Fishelson* 350 (K); Ascalona, in collibus arenosis, *Sieber s.n.* (Isotype, G, K); in planitie Philistaea at Chan-Junis (ad fines Aegypt.), May 27, 1897, *Bornmüller* 1171 (G, K). EGYPT: Sinai Desert, May 1916, *M. F. White* (K).

The oldest and best known species of the genus. It has been collected repeatedly in the deserts of North Africa, in all the states from Morocco to Egypt. For a widely distributed plant it is surprisingly constant. The

most conspicuous variation concerns the coloration of the calyx-lobes and the bracts of the inflorescence. These may be entirely green but usually tend to have a blue margin and because of their coloration can become very conspicuous. A form in which the blue calyx-lobes and bracts are margined with carmine red, thus giving the inflorescence a distinct reddish tonality, has been described from Tunis as the var. *marginata*.

The most important variation detected within *E. fruticosum* involves the shape of the nutlets. In plants ranging from Sinai northward along the Palestine coast, the var. *sieberi*, the nutlets are always lance-ovoid. The African plants, typical *E. fruticosum*, have bent nutlets. The longitudinal axis of the nutlet is not straight and vertical as in the nutlet of the Palestinian var. *sieberi*. It is medially bent 90° with the upper half vertical and the lower half horizontal and directed away from the axis of the fruit. In lateral outline the nutlets of typical *fruticosum* are sway-backed. The dorsal edge is not straight above the rounded base as in var. *sieberi* but incurving, sagging inward near the middle and suggesting a saddle in silhouette. In various genera of the family the nutlets have the body bent ventrally, towards the floral axis, cf. Jour. Arnold Arb. 35: 161 (1954), but dorsal bending, away from the axis, is rare and generally weak. The strong dorsally bent nutlets of *E. fruticosum* are perhaps unique in the family.

A careful description of the minor details of corolla structure is needed and should be prepared by someone with access to fresh material. On some corollas, below the middle of the large upper lip, I have observed a light-colored area upon which sand is usually found adhering. The area seems to bear numerous minute stipitate glands.

7. *Echiochilon arenarium* (Vatke), comb. nov.

Heliotropium arenarium Vatke, Linnaea 43: 319 (1882) — Type from Brava, Ital. Somaliland, *Hildebrandt 1314*. Not *H. arenarium* F. v.M. (1867–68).
Sericostoma arenarium (Vatke) Johnston, Contr. Gray Herb. 92: 92 (1930).

Plant fruticose with numerous very leafy much-branched prostrate or widely spreading stems 5–25 cm. long; foliage and new growth somewhat succulent, bearing loosely to closely appressed, uncrowded hairs 0.3–0.9 mm. long which usually arise from mineralized discoid bases; leafy branches 1–10 cm. long, internodes 1–10 mm. long; leaves numerous, oblanceolate, 2–20 mm. long, thickish, more or less conduplicate and having involute margins, upper surface concave or frequently hidden by the infolded margins, lower surface convex, not costate, apex obtuse or rounded; inflorescence multiflorous, terminating the leafy branchlets, usually a short dense unilateral and biseriate racemose cyme, commonly 1–2 cm. long but sometimes short and glomerate; calyx at anthesis 2–3 mm. long, sessile or with a stout pedicel 0.5 mm. long, lobes about equally long or moderately unequal, thick, united towards the base, bearing loosely appressed hairs arising from thickened bases, not costate, abaxial lobe usually tending to be broadest and even the longest; calyx in fruit 3–5 mm.

long, lobes usually thick; corolla apparently white, funnelform, 3–6 mm. long (usually 3–4 mm. long and only shortly surpassing the calyx), subcylindric below the middle, outer surface glabrous or sparsely hairy only on the lobes, limb 1.5–3 (–4.5) mm. broad; lobes ascending, equal or nearly so; throat inside bearing abundant white hairs; anthers 0.5–1 mm. long, usually included; filaments very short, equal, affixed at equal distances above the base of the corolla; gynobase pyramidal; style 1–3.2 mm. long, terminated by a pair of sterile attenuate lobes, lobes erect juxtaposed parallel slightly unequal in length, 0.2–0.5 mm. long; stigmas 2, forming the discrete halves of a pale, swollen, sometimes oblique, vesicular ring borne about the base of the bilobed sterile tip of the style; nutlets 1.2–2 mm. long, 1.0–1.7 mm. broad, thick, ovate in dorsal outline, obscurely tuberculate, back convex, venter obtusely angled, areole evident, obliquely basal, triangular or transversely elongate, abruptly contracted into a narrow lateral groove which is prolonged upward to above the middle of the nutlet.

Coastal dunes along middle and southern Italian Somaliland.

ITALIAN SOMALILAND: sand hills near Brava, March 1874, *Hildebrandt 1314* (frag. of Type, G; Isotype, BM); Mogadiscio, dune stabile, Aug. 8–9, 1929, *L. Senni 575, 596* (Fl); dintorni di Mogadiscio, *Ciferri 66* (Florence); spiaggia di Mogadiscio, May 17, 1913, *G. Paoli 5, 10* (Fl); Mogadiscio, nelle vicinanze del campo avicizione, April 9, 1939, *R. Corradi 6335* (Fl); littorale di Ras Mallen, 1890, *R. Bricchetti 512* (Fl); duna tra Magangib e Obbia, April 18–19, 1924, *Puccioni & Stefanini 369, 382* (Fl).

A very distinct species with salient characters in the prolonged sterile tip of its style, the short tube of the calyx, the white faucal hairs in the corolla and the short not abundantly flowered inflorescences. The plant is a small shrub with succulent herbage. It frequents dunes along the coast of Italian Somaliland. The prolonged sterile bilobed tip of its style is of some interest, since the sterile tip and the stigma together form an aggregate which is very suggestive of the stigmatic head in *Heliotropium*. Indeed, because of this similarity the species was originally proposed as a species of *Heliotropium* and some recent authors have been content to continue to treat it so. A comparison of the style of *E. arenarium* with that of other species of the genus makes it very clear that these are all similar in structure and organization. In the present species the sterile tips of the style are simply more generously developed and more prolonged than in other congeners. The similarity to the stigmatic head in *Heliotropium* is superficial. The closest homologies, outside *Echiochilon*, are to be found not in *Heliotropium* but rather in *Buglossoides* and *Lithospermum*, cf. Jour. Arnold Arb. 35: 161 (1954).

I have found abnormal flowers frequently developed on the herbarium specimens available to me. These flowers have corollas 6–9 mm. long. The tube, 4–6 mm. long and 1–1.5 mm. thick, is gradually narrowed upwards and then abruptly expanded into a campanulate or even hemispheric throat, 2.5–4 mm. long and 3–4 mm. thick. The corolla lobes are thick,

erect, rounded and 1.5–2 mm. long. The tissue of the tube and throat is heavily mineralized. Examination shows that such corollas are, or have been, inhabited by a hymenopterous (?chalcid) larva and are gall-like hypertrophies. They are especially well developed on *Hildebrandt 1314*, the original collection of the species. Monstrous flowers of similar nature have been observed in only one other species of *Echiochilon*, in *E. strigosum*, and then only in very limited numbers.

8. *Echiochilon jugatum*, sp. nov.

Herba perennis pilis abundantibus rectis valde appressis 0.2–0.5 mm. longis pallidis indumentum levum argentaceum formantibus vestita; caulibus numerosis decumbentibus ascendenter ramosis 1–5 dm. longis 1–2.5 mm. crassis, internodiis 2–5 (–10) mm. longis; foliis numerosis omnino oppositis decussatis ascendentibus vel supra medium plus minusve recurvatis carnis concavo-convexis 1.5–6 mm. longis utrinque dense strigosis nullo modo costatis, basi 1.5–3 mm. latis anguste 0.5–1.5 mm. lateque connatis; floribus oppositifoliis vel rariter axillaribus dissitis paucis apicem versus caulis ramorumque inter paria foliorum oppositorum gestis; calyce sessili sub anthesi 3.5–4.5 mm. longo, fructiferi ad 5 mm. longo, lobis saepe subaequilongis lanceolatis; corolla 5–6 mm. longa; limbo haud obliquo 5.5–7 mm. diametro; tubo (faucibus subcylindratis incluso) 3–4 mm. longo, intus basim versus inconspicue minutissimeque pubescenti; lobis patentibus aequalibus obtusis 2 mm. longis basim versus 2.5 mm. latis in faciebus utrinque albo-villulosis margine erosis; faucibus intus flavo-villosis; antheris exsertis 1.3–1.9 mm. longis; filamentis 0.8–1 mm. longis, omnibus ca. 3 mm. supra basim tubi orientibus; gynobasi pyramidalis 2–2.5 mm. longa basim versus ad 1.5 mm. lata; stylo 1.5 mm. longo apicem sterilem inconspicuum latum convexum stigmata horizontalia vix superantem proferente; nuculis ca. 3 mm. longis, 2 mm. latis, sublaevibus vel sparse verrucosis, cinereis vel rosaceis; cicatrice laterali verticali basi ad 1.5 mm. lata supra basim sursum abrupte deinde gradatim contracta.

Eastern Arabia, near the coast, from Bahrain Island south to Dhofar.

ARABIA: Bahrain Island, sandy desert at northwest end of pipeline, March 11, 1950, *Ronald Good 224* (BM, K); Dubai, Trucial Oman, sand on limestone near sea level, plant 11–18 inches tall, leaves gray green, fl. pale yellow, March 22, 1937, *Mrs. F. Holmes 351* (BM, K); Near Ras al Hadd, Gulf of Oman, sand dunes, Nov. 5, 1933, *H. Carry Gilson K 10* (K); near Jazir, Wadi Ghudun, long. 56°45'E, "Halmit," Feb. 9, 1947, *W. Thesiger* (BM); Wadi Shibun, long. 56°00'E, "Halmit," Feb. 11, 1947, *W. Thesiger* (BM); Dhofar Mountains, Marbat, coast, 1895, *Mrs. J. T. Bent 21* (Type, Kew); Red Sea, *Dr. Nimmo* (K).

The opposite leaves in *Echiochilon jugatum* are narrowly connate and accordingly arise from a short tight vaginate base. The flowers, usually borne opposite foliaceous bracts, occur along the terminal portion of the stems and branches and are usually separated by one to several pairs of leaves. There is no crowding of the flowers to form a differentiated race-

mose inflorescence. In other species of *Echiochilon* only the lowest leaves on the stem and branches are opposite, most of the leaves being alternate. In *E. jugatum* all the leaves are opposite. As to general facies I find the present species more suggestive of a member of the Caryophyllaceae or Chenopodiaceae than of the Boraginaceae. Among the members of *Echiochilon* the species most closely approaches *E. kotschyi* in habit as well as in other characters.

The collection from the "Red Sea" by Dr. Nimmo, cited above, is one of a number with such data contained in the Hooker Herbarium at Kew. J. B. Balfour, Bot. Socotra pg. xvi (1888), believes that some of these actually originated on Socotra. Indeed on most of Dr. Nimmo's collections from the "Red Sea," a definite locality "Socotra" has been added in pencil by some person unknown. I do not believe that Nimmo's material of *E. jugatum* came from either the Red Sea or the island of Socotra. The plant is definitely known only from Bahrain Island and from other localities in southeastern Arabia not far from the coast in Trucial Oman and in Oman. Nimmo also has a collection of *E. thesigeri*, a species that has been found in this same section of Arabia. Of special interest is a collection of *Cynoglossum* at the British Museum from Jabal Qara, Dhofar (*D. Vesey Fitzgerald 12448-4*) which without doubt is conspecific with a collection of Nimmo (from "Red Sea") in the Kew Herbarium. Although at first I believed an undescribed species was involved, much to my surprise I find that the Arabian plant is indistinguishable from *Cynoglossum coelestinum* Lindl. of the mountains of Bombay State, India. For the matter at hand the important fact is that this very distinct *Cynoglossum*, long ago found by Nimmo, has recently been localized in Arabia where it appears to be native. The locality in the mountains overlooking the Dhofar Coast is in the same general area as that in which Bent collected *E. jugatum*. From what is known of the distribution of *E. thesigeri*, that species can be expected eventually to be found also within this same general area. It is quite possible that Dr. Nimmo collected all three of the Boraginaceae mentioned during a visit to Dhofar, probably while his ship was at anchor at Marbat.

9. *Echiochilon kotschyi* (Boiss.), comb. nov.

Lithospermum kotschyi Boiss. & Hohenack. ex Boiss. Diag. Pl. Orient. Nov. 4: 49 (1844); Boiss. Fl. Orient 4: 219 (1875) — Type from Karrak Island, Persian Gulf, *Kotschy 15*.

Sericostoma kotschyi (Boiss.) Franchet in Révoil, Fauna et Flore Pays Çomalis (Sertulum Somalense) 46 (1882).

Plant suffruticose, pale strigose; hairs of indument white, rigid, abundant, strongly appressed, 0.5–1 mm. long; stems becoming 3 dm. long, at base 3 mm. thick; leafy branchlets numerous, strict, slender, usually ca. 1 mm. thick and 5–10 mm. long, internodes 1–5 mm. long; leaves abundant, 2–4 mm. long, 0.8–1.2 mm. broad, oblong, usually loosely recurving, upper surface concave, lower surface convex, apex obtuse; leaves mostly alternate, only the several lowest pairs of leaves on the shoot opposite;

flowers oppositiflorous, borne interspersed among the leaves above the middle of the leafy branchlets, not aggregated into a well-defined inflorescence; calyx-lobes all about the same length, about 4 mm. long at anthesis, shorter than the corolla-tube; corolla 5.5–6 mm. long, with a moderately oblique limb 4–5 mm. broad, the 2-lobed adaxial side of corolla ca. 0.8 mm. longer than the abaxial side, tube about 1.5 mm. thick at base, ca. 2 mm. long, short-cylindric, expanding into a throat ca. 2.5 mm. broad at the summit; throat inside bearing abundant yellow hairs; corolla-lobes strigulose on both surfaces, broadly triangular-ovate, 1.5 mm. broad, 1.2 mm. long, ascending, medial abaxial lobes slightly smaller than the other four; anthers 1.7 mm. long, only the tip of the adaxial anther exerted; filaments unguiculate, ca. 0.5 mm. long, affixed at unequal heights in the corolla-throat, adaxial one arising ca. 3.5 mm. above corolla-base, dorsal lateral pair ca. 3 mm. above base, and anterior pair ca. 2.5 mm. above corolla-base; style 1.5–1.7 mm. long, with a very short truncate or convex sterile tip surrounded by the two lobed horizontal vesicular stigma; nutlets pinkish, 2–2.3 mm. long, 1.5 mm. broad, nearly smooth, obscurely tumulose, areola lateral and vertical, 1 mm. wide at base, abruptly narrowed into a groove which extends upward almost to nutlet-apex.

IRAN: Korgo (Khargu) Island, Persian Gulf, ca. lat. 29°00', in arenosis, Jan. 7, 1842, *T. Kotschy 15a* (G, K); Karek (Kharg) Island, Persian Gulf, Jan. 1842, *Kotschy 15* (K, Isotype).

A plant growing in sand and known only from a group of small islands lying about 30 km. off the Iranian shore near the northern end of the Persian Gulf. Its relations are clearly with the Arabian *E. jugatum* and with *E. persicum* of Iran and Baluchistan. As in the species mentioned, the nutlets of *E. kotschyi* are nearly smooth and its indument is pallid. Our plant has noticeably more slender stems and leaves than *E. jugatum* and differs further in having most of its leaves alternate. *Echiochilon kotschyi* differs from *E. persicum* in inflorescence, zygomorphic corollas, small leaves and less roughened nutlets.

10. *Echiochilon vatkei* (Baker), comb. nov.

Heliotropium calcareum Vatke, *Linnaea* 43: 318 (1882), not Stocks (1852) —

Type from Yafir, Ahl Mountains, Brit. Somaliland, *Hildebrandt 890a*.

Heliotropium vatkei Baker in Thiselton-Dyer, *Fl. Trop. Africa* 4²: 39 (1905)

— a renaming of *H. calcareum* Vatke (1882), not Stocks (1852).

Sericostoma calcareum (Vatke) Johnston, *Contr. Gray Herb.* 92: 92 (1930).

Heliotropium thymoides var., sensu Vatke, *Oesterr. Bot. Zeits.* 25: 166 (1875).

Plant suffrutescent, 15 cm. tall; stems slender, numerous, ascendingly branched; leafy branchlets 1–5 cm. long, ca. 1 mm. thick, scantily strigose with stout straight hairs 0.5–1 mm. long, internodes 1–2 mm. long; leaves oblong to broadly oblanceolate, thickish, not costate, 2–5 mm. long, 0.5–0.9 mm. broad, mostly alternate, only the lowermost on the shoot opposite, bearing inconspicuous scattered stipitate glands, scantily strigose and bear-

ing some spreading hairs along the margin (hairs straight, 0.5–1 mm. long), upper surface concave, lower surface convex, apex rounded or obtusish; flowers borne opposite or lateral to a leaf at irregular intervals along the leafy (sometimes branching) ultimate twigs, not arranged in a well-developed, elongate unilateral inflorescence; calyx at anthesis 2–2.5 mm. long, in fruit becoming 4 mm. long and usually with a pedicel ca. 1 mm. long, lobes subequal, at anthesis ca. 2 mm. long, oblong or broadly spatulate; corolla 3.5–4 mm. long, funnelform, regular, limb 3–3.5 mm. broad, corolla-lobes ascending, 1.5 mm. wide, 1.0 mm. long, outer surface villulose-stri-gose, tube (including throat) 1–1.8 mm. long, throat densely yellow villulose inside; annulus represented by tufts of minute hairs borne in a band 0.3 mm. above corolla-base; filaments equal, 0.7 mm. long, arising at equal heights in the throat 1.5–1.7 mm. above the corolla-base, anthers 1.3 mm. long; style short, 0.6–0.7 mm. long, with a very short convex sterile tip; stigma 2-lobed; nutlets (only one developing) 2 mm. long, at base 1.5 mm. thick and 1.5–1.7 mm. broad, apex somewhat rostrate, surface somewhat reddish, verrucose; attachment-areole green, lateral, vertical, 0.5 mm. wide at base, abruptly narrowed upwards into a short groove, rarely prolonged above the middle of the nutlet.

BRITISH SOMALILAND: Yafir, Ahl Mts., 2000 m. alt., March 1873, *J. M. Hildebrandt 890a* (G, frag. of Type; BM, Isotype).

In having the flowers borne among the leaves along the outer portion of the leafy twigs and not in a well-defined, many-flowered unilateral racemose inflorescence, the present plant is distinguished from all other species known from British Somaliland. It is most closely related to *E. verrucosum*, from which it differs, in addition to the inflorescence, in having small leaves, a short style, and equal filaments all borne at the same height above the corolla-base.

The species is known only from the type collection obtained about Yafir, a broad pass near the crest of the Ahl Mountains, near long. 48°30'E, about 50 km. east-southeast of Las Gori, in extreme eastern British Somaliland. Under the incorrect name "*Heliotropium thymoides*," it is mentioned by Hildebrandt, *Zeitsch. d. Ges. f. Erdkunde*, Berlin, 20: 286 (1875), in the account of his visit to the Ahl Mountains.

11. *Echiochilon albidum* (Franchet), comb. nov.

Sericostoma albidum Franchet in G. Révoil, *Fauna et Flora Pays Çomalis (Sertulum Somalense)* 46 (1882).

Leaves densely and completely clothed by an abundance of appressed straight clean white somewhat lustrous hairs ca. 1 mm. long; corolla 4 mm. long, apparently regular; filaments equal, ca. 0.5 mm. long, arising ca. 2.5 mm. above the base of the corolla.

SOMALIA: no locality given, *Geo. Révoil 81* (Paris, Type).

A species known only from the type specimen which was collected at

some unrecorded locality in northeastern British Somaliland or in adjoining portions of extreme northern Italian Somaliland. George Révoil worked for a few days near Heis, but during most of his nine months in Somalia he travelled and studied in the area east and southeast of Las Khoreh (Las Gore), and as far eastward as Bargal on the shores of the Indian Ocean. At no time, however, was he ever more than 100 km. south of the shores of the Gulf of Aden, cf. G. Révoil, *La Vallée du Darror*, pp. 1-388, map, Paris, 1882.

I examined the type of the species at Paris but unhappily, except for the few details recorded above, my notes on the type have been lost. The plant seems to be most closely related to *E. verrucosum* of western British Somaliland. It differs in having a regular corolla with the stamens borne at equal heights on the corolla. Its most distinctive feature, however, is its dense indument of very abundant, very clean and white appressed hairs. A very few collections of *E. verrucosum* (e.g., Gillett 4026 from Hargesia) have a white indument but none of them has a snow-white or somewhat silvery white indument such as that possessed by the type of *E. albidum*.

Of the six species of the genus known from British Somaliland and adjacent extreme northern Italian Somaliland, only *E. verrucosum* is known from a goodly number of scattered collections. It appears to be widely distributed in the hills over the western half of British Somaliland and is there the only perennial representative of the genus. In the eastern half of British Somaliland and in adjacent Italian Somaliland the genus is represented by a number of apparently local species. Of the five occurring in this latter area (*E. arabicum*, *E. vatkei*, *E. collenettei*, *E. adenophorum* and *E. albidum*), only *E. arabicum* is known from more than a single station or has been collected more than once. The behavior of *Echiochilon* in eastern British Somaliland and in northern Italian Somaliland differs from that elsewhere within the geographic range of the genus. More species are concentrated in this area than in any other of comparable size. Also, the geographic distribution of the species of *Echiochilon* within the area is extremely localized as compared with those occurring elsewhere. Recognizing these facts, it seems wise therefore to accord at least conditional recognition to *E. albidum* until it has been recollected and more is known concerning the plant and its occurrence. If *E. albidum* is not a recognizable local endemic species of extreme eastern British Somaliland or adjacent Italian Somaliland, it may prove to be only a form of *E. verrucosum*. Should this be true, the name "albidum" being older than "verrucosum," the binomial *E. albidum* would become the correct one for the plant I have treated as *E. verrucosum*.

12. *Echiochilon strigosum* (Deflers), comb. nov.

Sericostoma strigosa Deflers, Bull. Soc. Bot. France **43**: 120 (1896) — Type from southwestern Arabia, Bilad Fodhli, ad fauces australes montis el'Areys, 500-600 m. alt. Deflers 1075.

Heliotropium deflersii O. Schwartz, Mitt. Inst. allgem. Bot. Hamburg **10**: 212 (1939) — based on *S. strigosa* Deflers (1896).

Plant suffrutescent, apparently prostrate; stems very slender and very loosely branched, 10–20 cm. long; leaf-bearing branchlets 5–12 cm. long, 0.5–1 mm. thick, densely strigulose (hairs 0.1–0.5 mm. long), with internodes 0.2–5 mm. long, bearing very numerous small leaves directly upon the branchlet and also in axillary fascicles; leaves linear or narrowly oblong, sessile, 1–6 mm. long, 0.5–1 mm. broad, becoming loosely but distinctly recurved, usually green, sparsely strigulose (hairs 0.1–0.8 mm. long) and sometimes sparsely ciliate (hairs 0.6–1.2 mm. long) below the middle, mostly alternate, with only the lowest 2–3 pairs on the shoot opposite; leaf-blade thickish, more or less conduplicate, the upper surface mostly hidden and apparently narrowed to a longitudinal groove, lower surface convex, not costate; inflorescence 10–20-flowered, unilateral, becoming loosely racemose, 1–7 cm. long, terminal on the branchlets; bracts small, linear, 1–2 mm. long; calyx at anthesis 1.5–2.5 mm. long, borne on a strict pedicel 0.5–1 mm. long, lobes linear, 1–2 mm. long, equal or nearly so, not costate; corolla 3–4 mm. long, unilaterally prolonged on the adaxial side, densely strigulose outside, limb moderately but distinctly oblique; corolla-lobes about equal, ca. 1 mm. diameter, usually with pale crisped margins, two rear lobes overtopping the other lobes 0.5–1 mm.; corolla-throat with abundant yellow hairs inside; annulus marked only by an indistinct inconspicuous band of minute hairs ca. 0.5 mm. above the corolla-base; anthers 0.7–0.9 mm. long, sometimes exerted; filaments unequal, 0.5–1.5 mm. long, arising at unequal heights above the corolla-base, one 1.5 mm. above the base, two ca. 1.8 mm. above the base and the remaining two 2–2.1 mm. above the corolla-base; gynobase broadly pyramidal; style 0.5–1.2 mm. long, the sterile tip convex, short; stigmas 2; nutlets 1.5–2 mm. long, above the base 1.5 mm. wide and 1.2–1.5 mm. thick, commonly 3–4 developing, back verrucose or somewhat papillate, venter with prominent scar and keel, attachment-scar lateral and vertical (or perhaps sometimes somewhat oblique), ca. 0.5 mm. broad, ovate or broader than long; groove closed or a narrow prolongation of the areola extending up to the middle of the nutlet.

Known only from the western half of the south coast of Arabia.

ARABIA: Montes el'Areys, Bilad Fodhli, 500–600 m. alt., April 28, 1893, *A. Defflers* 1075 (Paris, Type; G, fragment); hills near Dobaibah [35–40 mi. east-northeast of Mukalla], Hadhramaut, small plant, flowers pale blue, 3000 ft. alt., Feb. 28, 1894, *W. Lunt* 224 (K); between Mukalla and Sai'un, jol along East Road, Hadhramaut, March 30, 1952, *G. Popov* 530 (BM).

Among the distinctive features of *E. strigosum* are its very slender and very loosely branched stems, its very short, narrow, usually recurved leaves and its abundant, frequently crowded, axillary fascicles of leaves. On some plants the well-developed leaf-fascicles are so numerous and so crowded as to form a cylindrical mass of foliage 7–8 mm. in diameter that completely hides the twig within it. The species is a well-marked one, having its closest relations perhaps in *E. verrucosum* of British Somaliland.

Defflers appears to have collected the type of species in what is now known

as Dairi, Fadhli Sultanate, in the Aden Protectorate about 45–50 miles north-northeast of Aden. His collection is unquestionably conspecific with those I have cited from the Hadhramaut.

13. *Echiochilon persicum* (Burm. f.), comb. nov.

Heliotropium fruticosum var. *persicum* Burmann f., Fl. Indica 41, t. 19, f. 1 (1768) — Persia.

Heliotropium persicum Burmann f. Fl. Indica t. 19, f. 1 (1768); Lam. Encyc. 3: 94 (1789).

Sericostoma persicum (Burm. f.) B. L. Burtt, Kew Bull. 1949: 138 (1949).

Lithospermum persicum Gand. Bull. Soc. Bot. France 65: 62 (1918) — “Persia merid., Laristan ad Bender-Abbas (Bornmüller No. 521!).”

Lithospermum kotschyi var. *brevifolia* Bornmüller, Mitt. Thür. Bot. Vereins n.s. 6: 59 (1894) — “bei Bender-Abbas am Fusse des Kuh Ghino gesammelt.” *J. Bornmüller* 522, in pt.

A decumbent shrub with pallid herbage; old stems lignescent, as much as 8 mm. thick; leafy branchlets 5–15 cm. long, 1–2 mm. thick, simple or ascendingly branched above the middle, pallid strigose (hairs straight 0.5–1 mm. long, closely appressed), internodes 1–10 mm. long; leaves pallid-strigose and usually also more or less coarsely ciliate (hairs straight 0.5–1 mm. long), usually ascending, 3–15 (usually 5–10) mm. long, oblong or oblanceolate, 1–3 mm. broad, thickish, weakly conduplicate or the upper surface merely somewhat concave, lower surface convex, not costate; lowest 2–3 pairs of leaves on the shoot opposite, the others all alternate; inflorescence bracted, unilateral, 10–20-flowered, racemose, 3–8 cm. long, terminating the leafy shoots and their branches; bracts oblong, shorter than the calyx; calyx at anthesis 3.5–4 mm. long; lobes 2.5–3 mm. long, equi-long or nearly so; corolla 4.5–6 mm. long, tubular funnelform, abaxial side 1–1.5 mm. shorter than the adaxial side, outer surface minutely villulose; limb 4–6 mm. in diameter, moderately but distinctly oblique; corolla-lobes ascending, 1–1.5 mm. diameter, margins crisped, medial abaxial one slightly but perceptibly the smallest; throat inside bearing abundant yellow hairs; annulus usually marked only by an indistinct band of minute hairs ca. 0.5 mm. above corolla-base; anthers 1.2–1.7 mm. long, usually included; filaments 0.5–0.8 mm. long, unequal, borne at unequal heights (2.3–3 mm.) above the corolla-base; style 0.9–1.5 mm. long, sterile tip very short, low-convex; gynobase 1.5 mm. tall, abruptly narrowed above the broad (ca. 1 mm.) base; nutlets 2–2.3 mm. long, above the base 1.5–1.7 mm. broad and 1.3–1.6 mm. thick, gray or pinkish, usually one or more aborted, back convex, obscurely roughened or tumulose and with a few scattered prominent tuberculations; areola green, vertical (or rarely somewhat oblique), ca. 1 mm. broad, abruptly contracting into a narrow groove extending upward to above middle of the nutlet.

Known only from the coastal areas of southern Iran and Baluchistan.

IRAN: Henjam Island, Strait of Hormuz, *W. Wykeham* (K); sand hills near Bandar Abbas, Jan. 19, 1893, *J. Bornmüller* 521 (G); near Gahkum, lat. 28° 11' N,

long. $55^{\circ}50'E$, woody shrub 2 ft. tall, fl. brownish purple, silty plain, 3000 ft. alt., March 25, 1951, *G. B. Popov 46* (BM, G); Makran (perhaps near Jask, long. 58°), *Aucher-Eloy 5001* (K, P); Tcharbahar (Chahbar), Tiss, long. $60^{\circ}40'$ June 12, 1943, *A. Parsa* (K). PAKISTAN: Hala Range, long. $66^{\circ}E$., *Capt. Vicary* (K).

This species is the oldest in the genus. It was first described and figured nearly two hundred years ago from a plant said to have come from Persia. Unfortunately it was mistakenly identified with *Heliotropium*. Only recently was the true identity established by B. L. Burtt. This plant is the most easterly ranging member of *Echiochilon* and the only one known from the mainland of Iran or from Pakistan to the eastward. Its closest relation appears to be *E. kotschyi* of the islands of the Persian Gulf. The insular species, however, is very distinct, differing from *E. persicum* in its practically smooth nutlets, few-flowered inflorescence, small recurved leaves and its regular, rather than zygomorphic corollas.

14. *Echiochilon arabicum* (Schwartz), comb. nov.

Tetraedrocarpus arabicus O. Schwartz, Mitt. Inst. allgem. Bot. Hamburg 10: 212 (1939) — southern Arabia (Hadhramaut), near Mukalla, *Wissmann 1241*; on mountainsides behind Mukalla, near Lasb, *Wissmann 1240*; in the Wadi Himen, *Wissmann 1234*.

A small slender-stemmed grayish green shrub 1–5 dm. tall, hispid, loosely or densely branched; leafy branchlets 5–20 cm. long, 1–1.5 mm. thick, internodes 1–10 mm. long; older branches distinctly shrubby, 3–5 mm. thick, usually decorticated; leaves oblanceolate, all alternate or only the lowest pair on the shoot opposite, 5–15(–35) mm. long, from a narrow base gradually broadening and becoming 1–4 mm. broad between the apex and the middle, apex acutish, firm, thickish, weakly conduplicate, lacking midrib and veins, bearing stiff (even pungent) straight hairs 0.7–1.5 mm. long which arise from discoid bases, hairs loosely appressed or those along the leaf-margin more or less spreading; inflorescence elongating, racemose, unilateral, 10–40-flowered, becoming 5–17 cm. long; calyx 2–2.5 mm. long at anthesis, becoming 3–5 mm. long in fruit, base narrowed into a strict pedicel 1–2 mm. long, lobes about equally long but with the abaxial one broadest, without evident midrib; bracts numerous, mostly small and not surpassing the calyx; corolla 5–8 mm. long, funnelform, prolonged on the adaxial side, minutely hispidulous or villulose outside, tube 3–5.5 mm. long and 1–1.5 mm. thick expanding into a throat 2.5–3 mm. broad, limb distinctly, although only moderately oblique, sloping 25° – 35° from the horizontal; lobes prominently and dichotomously veined, inner surface sparingly white hairy above the base, the two adaxial lobes largest 2–2.5 mm. broad and 1.5–2 mm. long, medial abaxial lobe 1.5 mm. wide and 1 mm. long, anterior lateral lobes 1.7 mm. broad and 1–1.5 mm. long; corolla-throat bearing yellow hairs inside; anthers 1–1.2 mm. long, included or only shortly exerted; filaments borne at unequal heights above the corolla-base; medial adaxial filament 1–1.2 mm. long, arising 3–4 mm.

above the corolla-base; anterior pair of filaments 0.2–0.5 mm. long, arising 2–3 mm. above corolla-base; gynobase 2 mm. tall, attenuate, abruptly arising from a broad base, 1.5–2 mm. high, ca. 1 mm. wide at base; style 1.2–1.5 mm. long, sterile tip very short and broad, stigma not oblique; nutlets 1.5–2 mm. long, above the base 1.3–1.5 mm. broad and 1–1.5 mm. thick, usually verrucose, gray or somewhat reddish, 1–4 developing; areola green, base broad and more or less oblique, usually triangular (ca. 0.8 mm. broad and 0.4 mm. long), prolonged upward on the vertical ventral angle of the nutlet as an open groove reaching almost to the nutlet-apex.

ARABIA: (Hadhramaut): Mukalla, 1931, *H. v. Wissmann 1241* (G, fragment of Type); Lasb [mountain slope back of Mukalla], May 1931, *H. v. Wissmann 1240* (photo); el Sibeth [ca. 20 mi. north of Mukalla], 600 ft. alt., small straggling plant, flowers pale blue, Dec. 26, 1893, *W. Lunt 94* (BM, K).

BRITISH SOMALILAND: Serrut Mts., inland from Mait, limestone, fl. pale blue, 1800 m. alt., April 1875, *J. M. Hildebrandt 1416* (BM); Daageg delta, Heis, Erigavo Dist., fl. blue, bunch plant with thick taproot, Feb. 18, 1945, *Glover & Gilliland 715* (BM, K); Dubriet Mt., lat. 10°22'N, long. 45°10'E, 500 m. alt., fl. pale blue, open sandy soil, *J. B. Gillett 4776* (K, Fl).

Among the small-flowered members of the genus (spp. no. 7–17) the present one has the corollas which are most evidently zygomorphic and those which attain the largest size. The plant has relatively coarse foliage and has a thin open indument of loosely spaced, stiff, spreading or appressed hairs. It is, accordingly, a gray-green hispid plant and is more scabrous than other congeners. Because of these details I find the plant as to gross aspect very suggestive of the American genus *Cryptantha*.

In Arabia the species has been collected near Mukalla (the type locality) and also north of that port along the road to Wadi Hadhramaut. Two congeners have also been found in this general area, *E. strigosum* and *E. thesigeri*. Like *E. longiflorum*, the present species is known from southern Arabia and also from the adjacent African mainland. It occurs in the coastal mountains of middle British Somaliland, in an area in which the genus is otherwise represented only by the very different *E. longiflorum*, *E. adenophorum* and *E. vatkei*.

The present species was based by Schwartz on two collections. Through the kindness of Dr. Walter Domke of the Institut für allgemeine Botanik, Hamburg, I have had available for close study an excellent photograph of the type of the species, as well as a very generous fragment of the cotype. It has been possible, therefore, to identify Schwartz' proposed new genus and species with certainty, an operation impossible had I been forced to depend completely on the rather ambiguous original description.

15. *Echiochilon nubicum*, sp. nov.

Fruticulus decumbens pallidus 10–15 cm. altus e radice lignosa valida palari ad 13 mm. crassa erumpens pilis abundantibus albis ca. 1 mm. longis appressis vestitus; ramis vetustioribus lignosis 2–5 mm. crassis decorticatis prostratis vel laxe ascendentibus; ramulis hornotinis erectis vel ascendenti-

bus 5–15 cm. longis pallide strigosis saepe ascendenter ramosis foliosis 1–2 mm. crassis, internodiis 3–12 mm. longis; foliis oblongis vel saepissime oblanceolatis 7–14 mm. longis, 1–2.5 mm. latis alternis (vel solum eis basim versus ramulorum gestis oppositis) indumento pallido vestitis, supra concavis, subtus convexis haud costatis, margine crassis sparse hispido-ciliatis; inflorescentia ramulos foliosos terminanti 3–9 cm. longa densa unilaterali racemosa 10–20-flora bracteis obovatis vel obovato-oblongis instructa; calyce sub anthesi 2–2.5 mm. longo maturitate 2.5–2.9 mm. longo subsessili vel pedicello ad 0.5 mm. longo donato; lobis aequalibus oblongis maturitate apicem nucularum paullo superante; corolla 3–4 mm. longa extus minute villulosa, limbo ca. 3.5 mm. diametro horizontali, lobis homomorphis patentibus 0.8–1 mm. longis rotundis; faucibus intus flavo-villosis; tubo intus fere ad basim glabro vel annulo villuloso donato; antheris 0.9–1 mm. longis exsertis; filamentis aequalibus 0.3–0.5 mm. longis omnibus pari altitude (2–2.5 mm.) supra basim corollae affixis; gynobasi 1.2–1.5 mm. alta basi 1–1.3 mm. diametro deinde sursum abrupte contracta faciebus excavata; stylo 0.5–0.8 mm. longo supra stigmata horizontalia apicem sterilem inconspicuum perbreve proferente; nuculis 1.7–1.9 mm. longis 1.5 mm. latis, 1.3–1.5 mm. crassis sparse irregulariterque sed prominenter tumulosis et verrucosis, dorse obtusis carina imperfecta tuberculata donatis; cicatrice laterali prominenti basim versus 0.7–1 mm. lata supra medium nuculae apicem attenuatum producta.

SUDAN: Macaur [= Makawa] Island, Red Sea, lat. 21°, 1864, *G. Schweinfurth* 2108 (Type, Kew); Nubia, about lat. 21°, seacoast between 3000 and 4000 ft. alt., 1896, *J. T. Bent* (K).

A plant known only from the middle of the west side of the Red Sea. Because of its pallid indument I find it most suggestive of *Echiochilon persicum* as regards gross aspect. Its relationship, however, seems to be closest with *E. verrucosum* of British Somaliland and perhaps also with *E. thesigeri* of Arabia. Among the features of the plant useful in recognizing it are its white indument, stout sessile or subsessile calyces, small regular corollas, and very short style.

16. *Echiochilon verrucosum* (Beck), comb. nov.

Sericostoma verrucosum Beck in P. Paulitschke, Harar 457, f. 3–6 (1888) — Type from Wárabot, western Brit. Somaliland, ca. 10 km. south of Zeila, von Hardegger & Paulitschke.

Heliotropium albo-hispidum Baker in Thiselton-Dyer, Fl. Trop. Africa 4²: 39 (1905) — Type from Hammar, Golis Range, Brit. Somaliland, Feb. 9, 1895, Edith Cole.

Small usually gray-green shrubby plant; older stems lignescent, prostrate or decumbent, becoming 5 mm. thick; leafy branchlets cinereous, erect, 2–15 cm. long, ca. 1 mm. thick, somewhat strigose (hairs 0.6–1.2 mm. long), simple or ascendingly branched above the middle, internodes 1–10 mm. long; leaves linear or linear-ob lanceolate or sometimes oblanceolate, numerous 5–15 (usually 8–12) mm. long, ascending, 0.5–1 or sometimes

1.5 mm. broad, clothed with slender appressed hairs 0.5–1 mm. long, upper surface concave, lower surface convex, margin thick and usually sparsely hispid-ciliate; inflorescence terminating the leafy branchlets, erect, bracted, racemose, unilateral, 10–40-flowered, 5–14 cm. long; calyx at anthesis 2.5–3 mm. long, lobes linear or lanceolate, usually equal or nearly so but sometimes with the abaxial lobe enlarged; calyx in fruit somewhat accrescent, with stout ascending pedicel 0.8–1.5 mm. long; corolla 4–5 mm. long, outer surface strigulose or villulose, limb 3.5–5 mm. in diameter, symmetric or obscurely prolonged on the adaxial side, lobes usually equal or practically so, rounded, 1–1.5 mm. broad and ca. 1 mm. long, throat yellow-villous inside, annulus not differentiated, glabrous; anthers 1–1.2 mm. long, shortly exserted; filaments slightly unequal, 0.5–0.7 mm. long, affixed at unequal heights (at 2.4–2.5 mm., 2.6 mm. and 2.8–3 mm.) above the corolla-base; gynobase ca. 1 mm. broad at base, abruptly narrowing upward, 1–1.5 mm. high, faces excavated; style 1–1.3 mm. long, the sterile tip very short and convex, somewhat emarginate, scarcely surpassing the horizontal stigmas; nutlets usually rosaceous, 1–4 developing, verrucose or tuberculate, sometimes prominently and irregularly so, 1.8–2 mm. long, 1.5 mm. broad, 1.2 mm. thick, areola frequently green, lateral and vertical and tending to be prominent, from a broad base narrowing into an open groove extending upward towards the nutlet-apex.

Western British Somaliland, long. 43°00' to 45°15'E.

BRITISH SOMALILAND: Upper Sheik, long. 45°15'E. 1896–7, *Mrs. E. Lort Phillips* (BM); Daganah, 2000 ft., small shrub on rocks, May 30, 1949, *P. R. O. Bally 7266* (K, A); Golis Range, *Drake Brockman 229, 246* (K); Hammar, Golis Range, Feb. 9, 1895, *Edith Cole* (Kew, Type of *H. albo-hispidum*); Adadleh, Habrawal, long. 44°40'E. Feb. 20, 1899, *A. Donaldson Smith* (BM); Adda Gallah, April, *James & Thrupp* (K); Lafarug, April, *James & Thrupp* (K); Deragodle, in glareosis siliceis, Dec. 7, 1892, *D. Domenico Riva 257/13* (Fl); north of Hargeisa, 4800 ft., fl. cream, top of limestone hill, *J. B. Gillett 4026* (K, Fl); Afard, long. 44°8'E. 2000 ft., fl. white, schist slope, Oct. 24, 1932, *Gillett 4448* (K); Dobo Pass, long. 43°15'E., 4000 ft., May 2, 1933, *Gillett 4959* (Fl); betw. Gildessa and Zeila, 1889, *R. Bricchetti 37* (Fl).

From this plant of western British Somaliland the other small-flowered Somalian species are easily separable, *E. arenarium* by its style, *E. vatkei* by its inflorescence, *E. arabicum* by its coarser habit and larger, strongly zygomorphic corollas, and *E. albidum* by its dense, very clean, lustrous white indument. As mentioned in my discussion of *E. albidum*, that species is imperfectly known. Its relationship to *E. verrucosum* must remain in doubt until new collections of it become available for study and comparison.

17. *Echiochilon thesigeri*, sp. nov.

Fruticulus ad 4.5 dm. altus cinerascens; ramis vetustis decumbentibus lignescentibus 2–7 mm. crassis decorticatis; ramulis hornotinis foliosis 5–15 cm. longis 1–1.5 mm. crassis saepe ascenderis ramosis sparse strigosis

(pilis 0.5–1 mm. longis rectis valde appressis) internodiis 2–10 mm. longis; foliis 2–12 mm. longis 1–2 mm. latis oblongis vel oblanceolatis sparse strigosis plerumque alternis solum eis fere ad basim ramulorum gestis oppositis, supra concavis, subtus convexis haud costatis, margine crassis sparse hispido-ciliatis; inflorescentia 10–20-flora racemosa unilaterali 2–8 cm. longa ramulos foliosos hornotinos terminante, bracteis oblongis plerumque minus quam 3 mm. longis; calyce ad anthesin 2.5–3 mm. longo, maturitate 0.5–1.5 mm. longe pedicellato, lobis equalibus vel subaequalibus 2–3 mm. longis; corolla 3.5–5.5 mm. longa extus plus minusve villulosis, limbo 4–5 mm. diametro horizontali, lobis ca. 1 mm. longis et 1–1.5 mm. latis rotundis equalibus vel subaequalibus, faucibus intus abundanter flavo-villosis, tubo ca. 0.5 mm. supra basim inconspicue villuloso; antheris breviter exsertis 1–1.4 mm. longis; filamentis aequilongis ca. 0.5 mm. longis omnibus pari altitudine (1.6–3 mm.) supra basim corollae affixis; gynobasi basi 1–1.5 mm. lata deinde sursum abrupte attenuata 1–1.5 mm. alta; stylo 0.9–1.4 mm. longo supra stigmata horizontalia apicem sterilem truncatum perbreve vel subnullum gerente; nuculis rubicundis ca. 2 mm. longis 1.5 mm. latis et crassis irregulariter et saepe prominenter verrucosis, dorse obtusis imperfecte carinatis; cicatrice laterali verticali viridi ovata supra medium nuculae sursum in sulco producta.

ARABIA: Bahrain Island, Persian Gulf, stony desert south of rifle range south of Safral, March 14, 1950, *R. Good* 223 (K); Jabal Hafit, Oman, April 25, 1948, *W. Thesiger* (Type, Brit. Mus.); wadi ascending to jol behind Zamuk, 3400 ft., drainage runnels in sand, intricate shrublet 8–18 in. tall, fl. white and crimson with yellow eye, Feb. 27, 1952, *Popov, Tillin & Gilliland* 4212 (BM); on northern jol near Zamuk, 4000 ft. alt., gravelly drainage runnels, intricate rough-hairy shrublet 8–12 inches tall, fl. white becoming blue-purple with yellow hairy throat, Feb. 28, 1952, *Popov, Tillin & Gilliland* 4220 (BM); "Red Sea," *Dr. Nimmo* (K).

This plant of eastern and southern Arabia has a habit at times closely simulating that of *E. persicum* of Iran and especially *E. verrucosum* of British Somaliland. From both these species, however, it is readily distinguished by having the stamens all borne at the same distance above the corolla-base and by having a corolla with lobes that are equal or practically so and a limb that is not oblique. In addition to *E. thesigeri* the genus is represented in Arabia by *E. jugatum*, *E. strigosum* and *E. arabicum*, all three very well marked and readily recognizable species.

Among the five collections cited, that from Bahrain Island appears to be a plant from an unusually rigorous situation. Though it has very short stems and very small leaves, it seems to be otherwise characteristic of the species. One of the collections (No. 4220) from near Zamuk [apparently a locality northwest of the Wadi Hadhramaut] is typical except for the fact that some minute stipitate glands are present on the calyx and along the younger stems. The glands, however, are inconspicuous and to be seen must be searched for. They are not conspicuous and should not cause the plant to be confused with the abundantly glanduliferous *E. adenophorum* and *E. collenettei* of British Somaliland.